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DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes removing and disposing of materials as indicated on the plans or directed by the Engineer. The work also includes the backfilling of trenches, holes or pits that result from such removals.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. With certain exceptions, the Contractor shall raze, remove and dispose of all buildings and foundations, structures, fences and other obstructions that lie wholly or partially within the clearing limits. The exceptions are utility-owned equipment, items indicated to remain on the plans, and any other items the Owner may direct the Contractor to leave intact. The Contractor shall:
 - 1. Remove any structures, substructures, or foundations completely.
 - 2. Fill cavities left by the removal of structures. The fill shall match the level of the surrounding ground. Any such fill shall be compacted to meet the requirements of Section 31 00 00 Earthwork.
 - 3. Make a vertical saw cut between any existing improvements to remain and the portion to be removed.

4. Replace at no expense to the Owner any existing improvements to remain that are damaged during the removal of other improvements.
 5. Remove and store any items to be re-installed indicated on the plans.
- B. When salvageable material is to remain the Owner's property, the materials identified shall be removed as described herein.
- C. Any material not named as the Owner's property will belong to the Contractor. The Contractor shall store or dispose of such material off-site in a safe and legal manner at no expense to the Owner.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
- B. Related Sections:
 - 1. Division 03 "Concrete Finishes" for finishing of floors and slabs.
 - 2. Division 03 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, other pozzolans, slag cement, and silica fume; materials subject to compliance with requirements.
- B. Supplementary Cementitious Materials: Cementitious Materials other than Portland cement.
- C. W/C Ratio: The ratio by weight of water to cementitious materials.

1.04 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.

2. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.
- 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 couplers, tie spacing, spiral spacing, hoop spacing, and supports for concrete reinforcement.
- D. Embedded Item Placement Drawings: Drawings indicating the location and type of plates, anchorages, sleeves or other items to be embedded in cast-in-place concrete members and surfaces.
 1. Submit coordinated drawings combining embedded items from all trades.
 2. Locate embedded items relative to edges of and openings within concrete members.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 1. Location of construction joints is subject to approval of the Architect.
- F. Contraction Joint Layout: Indicate proposed location of contraction joints not shown on the drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturer testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories. Include mill test certifications for ASTM A 615, Grade 60, bars used as special ductile quality (SDQ) reinforcement.
 5. Waterstops.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semirigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Evaluation Reports: ICC-ES or IAPMO-UES report certifying product compliance with Project Building Code for each of the following:
 1. Mechanical Bar Couplers.
 2. Adhesives for post-installed dowels.
 3. Post-installed anchors.
- F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
- G. Curing Procedures: Written procedures indicating proposed methods for curing concrete and that address the following:
 1. Timing and rate of application of Evaporation Retarder , Curing Compound , Curing and Sealing Compound.
 2. Timing of installation of Moisture-Retaining Cover and Absorptive Cover.
 3. Duration of and methods for providing moist cure of Formed and Unformed Surfaces.
 4. Adjustments to curing procedures in the event of cold weather or hot weather as defined by ACI 306.1 and ACI 305.1, respectively.

1.06 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. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Keep reinforcement off ground by using pallets, dunnage, or other supports.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants

1.08 FIELD CONDITIONS

- A. 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 of highest and lowest ambient temperature from midnight to midnight 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.
- B. Hot-Weather Placement: Comply with ACI 305.1 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.

1.09 REDESIGN

- A. Redesign or Departures from Requirements of the Contract Documents Initiated by Contractor:
 - 1. Obtain written acceptance from the Architect and Architect's consultants.
 - 2. Bear costs for Contractor-initiated or construction error-caused changes to type, form, system, or details of construction from those indicated by the Contract Documents.
 - 3. Pay fees required by Architect and Architect's consultants for review of such changes.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301 "Specifications for Structural Concrete"
 - 2. ACI 117 "Specification for Tolerances for Concrete Construction and Materials"
 - 3. ACI 305.1 "Specification for Hot Weather Concreting"
 - 4. ACI 306.1 "Standard Specification for Cold Weather Concreting"
 - 5. ACI 308.1 "Specification for Curing Concrete"
 - 6. ACI 318 "Building Code Requirements for Structural Concrete"

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
 - 3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.03 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- D. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- E. Plain-Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.04 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.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to CRSI RB4.1-2016, "Supports Used for Reinforcement in Concrete". Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI RB4.1-2016 of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- C. Headed Deformed Bars: ASTM A 970/A 970 M.

- D. Mechanical Bar Couplers: Type 1 or Type 2 as indicated. Type 1 mechanical splices shall develop 125 percent of the specified yield strength of the spliced bars in both tension and compression. Type 2 mechanical splices shall develop the specified tensile strength of the spliced bars in tension in addition to meeting Type 1 mechanical splice requirements.

2.05 CONCRETE MATERIALS

- A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. 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.
- C. Cementitious Materials:
1. Portland Cement: ASTM C 150, Type I
 2. Fly Ash: ASTM C 618, Class F
 3. Slag Cement: ASTM C 989, Grade 100 or 120.
 4. Blended Hydraulic Cement: ASTM C 595, Type IS (<70) (portland blast-furnace slag), Type IP (portland-pozzolan), Type IL (portland-limestone), Type IT (S<70) (ternary blended) cement.
 5. Silica Fume: ASTM C 1240, amorphous silica.
- D. Normal-Weight Aggregates: ASTM C 33, Class 3 Coarse aggregate or better, graded. Provide aggregates from a single source
1. Maximum Coarse-Aggregate Size: Unless maximum coarse aggregate size is otherwise specified, the maximum aggregate size shall not exceed:
 - a. Three-fourths of the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, prestressed reinforcement, individual tendons, bundled tendons or ducts.
 - b. One-fifth of the narrowest dimension between the sides of the forms.
 - c. One-third of the depth of the slabs or toppings
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 7. Viscosity Modifier: ASTM C 494/C 494M, Type S.
- G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
- H. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- I. Water: ASTM C 94/C 94M and potable.
1. Do not use undocumented nonpotable water for concrete mixes.
 2. Recycled water may be used in conformance with ASTM C 94, including optional chemical limits
 3. Wash water may be used in conformance with ASTM C1602.

2.06 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Profile: Flat, dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick) nontapered.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
1. Profile: Flat, dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick) nontapered.
- C. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Profile: Flat, dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick) nontapered.
- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.07 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.
- C. Bituminous Vapor Retarder: 110-mil- (2.8-mm-) thick, semiflexible, 7-ply sheet membrane consisting of reinforced core and carrier sheet with fortified asphalt layers, protective weathercoating, and removable plastic release liner. Furnish manufacturer's accessories including bonding asphalt, pointing mastics, and self-adhering joint tape.
 - 1. Water-Vapor Permeance: 0.00 grains/h x sq. ft. x inches Hg (0.00 ng/Pa x s x sq. m); ASTM E 154.
 - 2. Tensile Strength: 140 lbf/inch (24.5 kN/m); ASTM E 154.
 - 3. Puncture Resistance: 90 lbf (400N); ASTM E 154.

2.08 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
- B. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.09 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating.
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.
- C. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; of width and thickness indicated; formulated from neoprene urethane or PVC.
- D. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- E. 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 Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- F. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

- G. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- H. Plastic Bearing Pads: Non-leaching, non-staining, high-density polyethylene or high impact polystyrene with a minimum compressive strength of 6,000 psi.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.12 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 (ACI 301M).
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
 - 2. Concrete mix designs shall comply with the requirements of the structural drawings.
 - a.
- B. Limit water-soluble, chloride-ion content in hardened concrete to the maximum allowed in ACI 318 with the Exposure Class listed on the Contract Documents.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.13 FABRICATING REINFORCEMENT

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

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is 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.
 2. Batch Tickets: Include the amount of water in the batch from the plant and the remaining water that may be added at the site, if any.
- 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. (0.76 cu. m) 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. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
- C. 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

3.01 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M) to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEM INSTALLATION

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

1. Install anchor rods and embedded structural steel items, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.03 REMOVING AND REUSING FORMS

- A. Formwork that does not support weight of concrete in place, such as for sides of beams, walls columns and similar parts of the Work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 <Insert number> hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
- B. Leave formwork that supports weight of concrete in place, such as for beam soffits, joists, slabs, and other structural elements, a minimum of 3 days and until concrete has achieved at least 70 percent of its design compressive strength, whichever is longer.
 1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores. For formwork systems where removal of forms cannot be completed without loosening or disturbing shores, formwork shall be left in place no less than the required shoring duration.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 VAPOR RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, terminate and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.05 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" and CRSI RB4.1 "Standard for Supports for Reinforcement Used In Concrete" for fabricating, placing, and supporting 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 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. Defective Work: The following reinforcing steel work will be considered defective and shall be removed and replaced by the Contractor at no additional cost to the Owner:
 - 1. Bars with kinks or bends not shown on the drawings.
 - 2. Bars damaged due to bending or straightening.
 - 3. Bars heated for bending.
 - 4. Reinforcement not placed in accordance with the drawings.

3.06 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 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 (38 mm) into concrete.
 - 3. Roughen surfaces of joints to full amplitude of approximately 1/4 inches (8 mm) as indicated.
 - 4. Locate joints for slabs between L/3 and L/5 from end of span. Locate joints for beams within the middle third of span. Joints in girders are not permitted.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 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 as indicated of concrete thickness and 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 (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with early-entry dry-cut power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete as soon as cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Cutting of joints shall be made within 4 hours from time of concrete finishing; adjust timing as required to preclude damage to the concrete due to raveling adjacent to the joint.
- 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 (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "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. Coat one-half of dowel length with form-release agent to prevent concrete bonding to one side of joint where indicated.

3.07 WATERSTOP INSTALLATION

- A. Provide waterstops where indicated and for all construction joints at or below elevation <Insert Elevation>. Install in longest lengths practicable and according to manufacturer's written instructions.
- B. Flexible Waterstops: Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- C. Self-Expanding Strip Waterstops: Install using adhesive bonding, mechanically fastening, and firmly pressing into place.

3.08 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, only to the amount listed on the batch ticket, subject to limitations of ACI 301 (ACI 301M).
 - 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 is 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 not to 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 (ACI 301M).
 - 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 (150 mm) 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. Scream 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.

3.09 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of

seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
1. Apply scratch finish to surfaces to receive concrete floor toppings
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces to receive trowel finish

- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighthen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view
 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
 3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset 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.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- 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.

- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures in accordance with submitted Curing Procedures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
 - 1. Evaporation Retarder may be omitted if the Curing Procedures demonstrate that moisture loss will not exceed 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Such determination must be based upon concrete mix characteristics and ambient environmental conditions at time of placement.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days.

Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer
 4. 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.

3.13 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than three days old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. 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 (0.25 mm) 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) 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.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Perform structural repairs of the following cracks using epoxy resin adhesive by injection as directed by the Architect.
1. Cracks in excess of 0.01 inch (0.25 mm) which extend through the full depth of a slab or wall.
 2. Cracks in excess of 0.015 inch (0.38 mm) which do not extend through the full depth of a slab or wall.
 3. Cracks which are subject to allowing water leakage through the crack.
- G. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Tests and Inspections: As indicated on the structural drawings.
- D. 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.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- I. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 03 30 03

UNDERSLAB VAPOR RETARDER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Under slab vapor retardant sheeting at interior slabs on grade.
- B. Taped seams and openings.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Divisions 20 and 30 Facility Services Subgroup: plumbing and electrical penetrations
- C. Division 30 Sections on Earthwork, Excavation and Backfill

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 00 – Project Coordination.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.
- B. Coordinate penetrations through vapor retarder.
- C. Select screeds and other concrete work accessories to ensure no penetration of the vapor retarder during concrete work.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For Manufacturer, design engineer, fabricator, and installer.
- C. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Product Data: Published descriptive literature for vapor retarder and patching materials.

- E. Shop Drawings: Indicate required flashings, sealing at openings.
- F. Sample: 12 inches by 12 inches.
- G. Certified Test Data: Include manufacturer's test data results, certified in writing from independent testing agency.
- H. Manufacturer Instructions: Installation instructions, special procedures, and perimeter, penetration and other conditions requiring special attention. Include limitations.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommended schedule of maintenance.

1.05 MAINTENANCE MATERIAL

- A. As required by Section 01 78 23 – Operations and Maintenance Data.
- B. Spare parts, extra stock, tools.

1.06 QUALITY ASSURANCE

- A. Geotechnical Report: Report made available to bidders is not a Contract Document. Do not follow Geotechnical Report recommendations that differ from Contract Document provisions.
- B. Do not install sand layer or any other material over vapor retarder prior to placement of concrete slab-on-grade.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Take precautions to prevent puncturing and tearing vapor retarder.

1.08 WARRANTY

- A. Installation Warranty: Contractor shall correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Class A, sheet vapor retarder in accordance with ASTM E 1745. Moisture Vapor Permeance: 0.01 perms. Thickness: 15 mils minimum.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Thickness: 15 mil minimum.
- B. ASTM E 1745, Class A, sheet vapor retarder.
- C. Moisture Vapor Permeance: 0.01 perms when tested to ASTM E 154, after mandatory conditioning tests per sections 8,11,12, and 13.
- D. Puncture Resistance: Minimum 2200 grams, tested to ASTM D 1709 Method B.
- E. Tensile Strength: 45 foot-pounds per inch, tested to ASTM E 154, Section 9, Method ASTM D 882.
- F. Initial Tear Resistance: Minimum 8.0 pounds force in machine direction and transverse direction, tested to ASTM D 1004.
- G. Low Temperature Impact: Pass minus 120 degrees C, tested to ASTM D 1790.

2.03 MANUFACTURERS

- A. Fortifiber Corp., Moistop Ultra 15; www.fortifiber.com.
- B. Stego Industries LLC; Stego Wrap; www.stegoindustries.com
- C. W.R. Meadows Sealtight; Perminator; www.wrmeadows.com.
- D. Specification is based on products listed below by manufacturer.
 - 1. Substitutions for products by other manufacturers: See Section 01 60 00 - Product Substitution Procedures.

2.04 MATERIALS

- A. Vapor Retarder
 - 1. Basis of Design Product: Stego Wrap by Stego. Comparable and substituted products will be judged based on the following performance criteria, features, warranty, and qualifications.
 - 2. Features:
 - a. Forest Certification: For the following wood products, provide materials produced from wood complying with FSC STD-01-001, FSC Principles and Criteria for Forest Stewardship.
 - b. Recycled Content: (and other sustainability things pertaining to material 1 and not other materials.)
 - c. of the product, thickness, weight, (used to list what

- features are important to the design).
- d. Profile: To be selected from manufacturer's full range.
- e. Finish: To be selected from manufacturer's full range.

2.05 ACCESSORIES

- A. Pressure Sensitive Tape: As instructed by manufacturer.
- B. Seam Splice Tape Primer: As instructed by manufacturer.
- C. Other Accessories: As instructed by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section before beginning.
- B. Verify subgrade free from conditions that may cause puncture or other damage to vapor retarder.

3.02 PREPARATION

- A. Complete substrate work before beginning work of this Section.
 - 1. Compacted Structural Fill per structural notes and Division 31. Level, tamp or roll as necessary for smooth level surface prior to installation of vapor retarder.
 - 2. Through-Slab Penetrations: Ensure that drain lines, electrical conduit and other utilities of Division 15 thru Division 16 are in place and firmly anchored

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, and ASTM E 1643.
- B. Interior Concrete Slabs-On Grade: Provide vapor retarder where indicated on drawings.
- C. Install vapor retarder sheet over compacted base.
- D. Roll down vapor retarder in widest practical width, parallel with direction of concrete pour, and with minimum number of joints.
- E. Lap vapor retarder over footings and seal with pressure sensitive tape to foundation wall.
- F. Overlap joints 6-inches minimum and seal with pressure sensitive tape.
- G. Promptly patch tears and punctures as they occur.
- H. Repair damaged areas by cutting vapor retarder as patches. Overlap tears and

holes 6-inch beyond damaged area with patches. Seal patch to installed vapor retarder with pressure sensitive tape or as instructed by manufacturer.

- I. Seal pipe penetrations and other openings through concrete slab with vapor retarder or factory fabricated boots and pressure sensitive tape. Field fabricate boots and other shapes as necessary to seal vapor retarder against vapor penetration.
- J. Place concrete slab-on-grade directly over installed vapor retarder under work of Section 03 30 00. Do not install granular fill layer over vapor retarder.

3.04 FIELD QUALITY CONTROL

- A. Inspect completed installation prior to placing concrete slab-on-grade in accordance with Section 01 41 00 – Regulatory Requirements.
- B. Verify vapor retarder installed in accordance with manufacturer's instructions with permanent penetrations taped and sealed.
- C. Verify that vapor retarder has not been penetrated by screed stakes and that base set screed posts are in place.

3.05 ADJUSTING

- A. Patch penetrations with pressure sensitive tape and make adjustments as necessary to maintain performance of vapor retarder as instructed by manufacturer.
- B. Do not patch or seam when vapor retarder is wet.

3.06 CLEANING

- A. Dispose of all waste material legally.

3.07 PROTECTION

- A. Protect From Penetration: Do not permit use of ground set stakes, screed posts, and other items to puncture vapor retarder. Where punctured, remove penetrating item and patch vapor retarder, as specified in this section, before placing concrete.
- B. Lay plywood or other protection board over installed vapor retarder at areas of heavy traffic and other construction loads. Do not stack construction materials directly on vapor retarder.

3.08 SCHEDULE

- A. Locations: All slab on grade locations over sand and engineered fill as indicated.

END OF SECTION

SECTION 03 35 13

CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Finishing slabs on grade and monolithic floor slabs.
 - 1. This section further defines the use of finishes of both formed and unformed surfaces specified in Section 03 30 00, it does not replace those requirements.
 - 2. The floor flatness and levelness recommendations of ACI 302.1R referenced below, are written for slabs on grade and supported slabs at the time of initial concrete placement and finishing. This specification requires achievement of floor flatness and levelness at the time of application of final floor covering.
- B. Surface treatment with sealer at areas not receiving a polished finish.
- C. Concrete formwork for Textured Architectural Concrete (aka Board Formed).

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 – Concrete Reinforcement
- B. Section 03 30 00 – Cast-in-Place Concrete
- C. Section 03 30 03 – Underslab Vapor Retarder
- D. Section 07 90 05 – Joint Sealers
- E. Section 09 90 00 – Paintings and Coatings

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with 01 30 00 – Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.
- B. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide data on sealer and other manufactured products, including

information on compatibility of different products and limitations.

- C. Map and Test Data: Provide floor flatness and levelness measurements and test locations.
- D. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.06 FIELD CONDITIONS

- A. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 square foot of floor being finished.

1.07 WARRANTY

- A. Installation Warranty: Contractor shall correct defective Work within a 2-year period after Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Concrete Floor Flatness: Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E 1155.

2.02 ARCHITECTURAL CONCRETE FORMWORK

- A. Smooth Architectural Concrete:
 - 1. High Density Overlaid panel or other approved non-absorptive panel materials that will provide continuous, true, and smooth Architectural concrete surfaces.
 - a. Furnish in largest practicable sizes to minimize number of joints
 - b. New or very clean - no scratches or indentations or other scars allowed.

2.03 COMPOUNDS - HARDENERS AND CLEALERS

- A. Chemical Sealer-Hardner:
 - 1. Concrete Floor Sealer/Finish: Liquid chemical hardener; silicate type. Subject to compliance with requirements, provide products by one of the following:
 - a. Curecrete Chemical, "Ashford Formula" (enhanced silicate, not silicate).
 - b. L & M Chemical, "Seal Hard."
 - c. Euclid Chemical "Diamond Hard".
 - d. Dayton Superior "Day-Chem Sure Hard J-17".

- B. Dustproofers:
 - 1. Penetrating Liquid Dustproofers: Clear, chemically reactive, waterborne solution of materials and proprietary components; odorless; colorless; that penetrates, densifies and dustproofs concrete surfaces. Provide products manufactured by one of the following, or approved:
 - a. Dayton Superior Corporation.
 - b. Euclid Chemical Company.
 - c. L&M Construction Chemicals, Inc.
- C. Concrete Cleaner:
 - 1. Liquid concentrate, biodegradable, heavy-duty cleaner-degreaser compound.
- D. Substitutions: See Section 01 60 00 – Product Substitution Procedures.

2.02 CONCRETE SEALER AT INTERIOR FLOORS

- A. Acceptable Product: Dayton Superior, Sure Hard (J-17) or other reviewed and accepted.
- B. Local Manufacturer's Representative: Steve Hackworth, Email: stevehackworth@daytonsuperior.com; Local Distributor: Industrial Coatings & Sealants, Inc., Tel. (253) 872-4411 x-56105; Cell. (253)-245-0263; www.coatingsandsealants.com; Contact: Greg Tadie.
- C. Penetrating water-based liquid sealer with hardener and dustproofing properties. Sealer shall be non-yellowing;
 - 1. VOC: 0 g/L.
 - 2. Depth of penetration: 5 mm (.20-inch) into concrete.
 - 3. Water Absorption: ASTM C-642, 3.4% in 24 hours.
 - 4. Water Vapor Transmission Rate: 217 grams/sf - 24 hours.
- D. Sheen: Satin sheen as established with Architect reviewed and accepted Mock-ups. The treated surface will develop an increased polished appearance over time.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.

3.02 CAST-IN-PLACE ARCHITECTURAL FINISH

- A. Reduce all tolerances to 1/2 of the permitted tolerance of ACI 117.

3.03 FLOOR FINISHING

- A. Finish concrete floor surfaces in accordance with ACI 301, ACI 302.1R, and ACI 117.

- B. Steel trowel surfaces that are scheduled to be left exposed, unless otherwise noted.
- C. Light broom finish surfaces left exposed, as noted these specifications.
- D. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 1/8-inch per foot nominal.
- E. In areas with floor drains and in areas indicated on drawings slope surfaces uniformly to drains.
 - 1. Floors not so indicated, are to be finished flat and level.

3.04 FLOOR SURFACE TREATMENT

- A. Apply hardener to scheduled floor surfaces in accordance with manufacturer's instructions.
- B. Apply slip resistant finish to scheduled floor surfaces in accordance with manufacturer's instructions.
- C. Apply sealer to floor surfaces in accordance with manufacturer's instructions.
- D. Apply retarder to exposed aggregate floor surfaces, as scheduled, in accordance with manufacturer's instructions.

3.05 FLOOR TOLERANCES

- A. The architect will observe the finished slabs for flatness.
- B. Measure flatness of slabs in accordance with ACI 302.1R and to achieve the following tolerances.
- C. Finish concrete to achieve the following tolerances:
 - 1. Maximum Variation of Surface Flatness For Exposed Concrete Floors: 1/4-inch in 10 ft.
- D. Measure for F(F) and F(L) tolerances for floors in accordance with ASTM E 1155 and ACI 117. Measurement at the time of initial finish is optional for above grade slabs and required for on grade slabs.
 - 1. The F(f) and F(L) requirements of this specification are for final floor finish and are not optional for any slabs.
- E. Finish concrete either during initial finishing or prior to final floor finish application to achieve the following tolerances:
 - 1. Building:
 - a. Polished Concrete Floors: Ff 55 (40 local) and FI 55 (40 local).
 - b. Exposed to View and Foot Traffic: Ff 35 (25 local) and FI 25 (17 local).
- F. Finish at sloped floors; flatness as indicated above for the finish flooring;

slope as indicated on drawings. Minimum of 1/8-inch per foot if not indicated.

3.06 DEFECTIVE CONCRETE

- A. Definition: Concrete not conforming to required lines, details, dimensions, flatness, tolerances or specified requirements.
- B. Test Results: The testing agency shall report test results in writing to Consultant and Contractor within 24 hours of test.
- C. Repair or replacement of defective concrete will be determined by the Consultant. The cost of additional testing or replacement of concrete shall be borne by Contractor when defective concrete is identified.
- D. Correct the slab surface if tolerances are less than specified.
 - 1. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.
- E. Do not patch, fill, touch-up, repair, or replace concrete to be left exposed except upon express direction of Consultant for each individual area.
- F. Architectural Concrete may not be patched.

3.07 MISCELLANEOUS PENETRATIONS

- A. Pipe and ducts not formed into the concrete by their placement or by the use of void forms must have any gap between the item and the concrete filled with non-shrink grout. If the penetration passes through an exterior wall exposed to drainage and/or weather, the exposed area must be waterproofed and sealed to insure against leakage.

3.08 FINISH DEFINITION

- A. Finish concrete floor surfaces in accordance with Standards listed in References above.
 - 1. Floor finish noted below, and floor levelness or flatness noted above are not necessarily related.
- B. Light Broom Finish applied with a stiff broom lightly applied to the concrete to providing a non-slip surface with a lighter texture.
- C. Full Steel Trowel Finish: Tolerance for these floors as noted above.
- D. Sealer Finish:
 - 1. After finishing operations (trowel finish or broom finish) are complete, precast panels have been lifted into place, and slabs are ready for final treatment, thoroughly clean surface to remove curing membrane and other residue and apply concrete floor sealer.
 - 2. Location: At all interior exposed slabs subject to pedestrian traffic, unless indicated otherwise.

- E. Architectural Formed Finish: Light Sandblast per ACI 303R and approved in field.

3.09 CLEANING

- A. Dispose of all waste material legally.

3.10 APPLICATION OF CONCRETE SEALER

- A. Refer to Section 07 19 10 – Water and Graffiti Repellents for penetrating water repellent for interior and exterior concrete walkways.
- B. Apply in accordance with manufacturer's installation instructions.
- C. Concrete must be allowed to cure a minimum of 7 days prior to application of liquid sealer.
- D. Exposed architectural concrete floors indicated to be hard troweled that have not achieved acceptable levelness and smoothness tolerances will require the additional step of polishing with diamond polishing discs until acceptable levelness and smoothness of floor has been achieved.
- E. All surfaces to be treated must be clean and sound. Remove all membrane forming curing compounds, sealers, oil, grease, dirt and other contaminants. For best results, remove any concrete laitance and patch or fix all cracks and damaged areas in method acceptable to Architect.
- F. Floor should be cleaned and allowed to dry.
- G. Apply sealer with low-pressure spray equipment at application rate recommended by manufacturer. The floor should be completely saturated with material. Normally this will require a 1st coat application at the rate of 200 square feet per gallon. The application rate may vary due to the porosity of the floor. More porous floors will require additional material.
- H. After applying, the material shall be continuously worked with a floor scrubber with manufacturer recommended pads for 15-20 minutes or until the material begins to gel. The use of a mechanical scrubber will increase the effectiveness of the application. The floor must be kept wet with material while the scrubbing process is proceeding.
- I. If a second coat is required, immediately apply it in a same manner as the first coat. Do not allow the surfaces treated to dry between applications.
- J. After scrubbing is completed, all excess material on the surface should be thoroughly flushed from the floor.

3.11 SCHEDULE

- A. Full Steel Trowel Finish for polishing: Entry 101, Break Room 102, Restroom 103.

- B. Steel Trowel Finish: Utility 104.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Description of Work
 - 1. The extent and location of the "Metal Fabrication" Work is indicated in the Contract Documents. The work includes the requirements for providing all stainless steel metals not specifically described in other Sections of these specifications but required for a complete and operable facility.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

- A. Governing Codes Standards and References
 - 1. Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - a. SMACNA, Architectural Sheet Metal Manual
 - 2. American Society for Testing and Materials (ASTM)
 - a. AWS D1.3 "Structural Welding Code, Sheet Steel"
 - 3. Specialty Steel Industry of North America
 - a. SSINA, Stainless Steel Primer and Designer Handbook, Special Finishes for Stainless Steel

1.03 SUBMITTALS

- A. Submit materials data in accordance with Section 01 33 10 – Submittals. Furnish materials literature, product specifications, and installation instructions for all products.
- B. Submittals shall include the following:
 - 1. Shop Drawings shall show all locations, markings, quantities, materials, sizes and shapes and indicate all methods of connecting, anchoring, fastening, bracing and attaching to the work of other trades.
 - 2. Mill certificates. Signed by manufacturers of stainless steel sheet certifying that products furnished comply with requirements.
 - 3. Samples:
 - a. Eight-inch square samples on metal of the same gage, alloy and finish to be used in the Work. Where normal color and texture variations are to be expected, include two or more units in each set of samples showing limits of such variations.
 - b. Six-inch-long samples of distinctly different non sheet materials and assemblies, including fasteners.
- C. Shop Drawings Submittal Requirements
 - 1. Plans, elevations, sections and details of all elements, including fittings, connections, fasteners and anchorages to other Work.

1.04 QUALITY ASSURANCE

- A. Qualification of Fabricator: The fabricator of the metals specified in this Section shall have a minimum of five years of experience working in the fabrication and working of metals, including cutting, bending, forming, welding and finishing.

PART 2 - MATERIALS

2.01 PROJECT INFORMATION

- A. Location as noted on the drawings.

2.02 FABRICATION, PRODUCTION AND SUPPLY OF MATERIALS

- A. All miscellaneous metal shall be fabricated in accordance with the approved shop drawings.
- B. Insofar as practicable, shop-prefabricate all items complete and ready for installation.
- C. Unless otherwise indicated on the drawings, weld all shop connections. All joints shall be tightly fitting, securely fastened, square, plumb, straight and true.
- D. Minimize weld diameter, spatter.
- E. Employ the appropriate tool and abrasive defined for the specific weld treatment, location and finish.
- F. Grind marks and burns from grinding/sanding are unacceptable.
- G. Source of Materials:
 - 1. All materials shall be fabricated or otherwise fashioned by a single fabricator.

2.03 MATERIAL REQUIREMENTS

- A. Mop Sink Wall Guard - Vertical
 - 1. Shape: Stainless Steel Sheet.
 - 2. Stainless Type: 304.
 - 3. Thickness: 20ga.
 - 4. Mechanical Finish: #4 finish vertical when installed.
 - 5. Dimensions: Fabricate from single piece with each leg the width of the janitors sink, height of 16-inches. Location as noted on the Drawings.
 - 6. Fastening: Countersunk 18-8 stainless steel #8 x 1-1/2-inch #2 square drive screws at 16-inches on center, typical each side.
- B. Continuous Fabricated Gutter with End Caps and Stiffeners
 - 1. Shape: Stainless Steel Sheet.
 - 2. Stainless Type: 304.
 - 3. Thickness: 16ga.
 - 4. Finish: Mil finish.
 - 5. Perforation: 3/16-inch round on 5/16-inch staggered centers with 33% open area.

6. Dimensions: Fabricate from minimum 10-foot lengths with eased edges. Location and dimensions as noted on the Drawings.
 7. Fasteners: 18-8 stainless steel #10-12 x 4-inch #2 square drive pan head screws at 30-inches on center.
 8. Stiffners: Fabricate from the same material as the gutter. Weld to the interior, no visible welds or burn marks. Locate 36-inches O.C., dimensions as noted on the Drawings.
- C. Continuous Fabricated Gutter Cover
1. Shape: Stainless Steel Sheet.
 2. Stainless Type: 304.
 3. Thickness: 16ga.
 4. Finish: Mil finish.
 5. Dimensions: Fabricate from minimum 8-foot lengths with fully welded seams and endcaps. Dimensions and location as noted on the Drawings.
 6. Fasteners: Tamper Resistant #8 x 1-inch, 18-8 Stainless Steel, Plain, Button head, Torx screw. Fasten to stiffners.
- D. Door, Window and Louver Surround
1. Shape: Steel Plate
 2. Steel Type: A36
 3. Thickness: 12-gauge
 4. Finish: Painted, see specification Section 09 90 00 – Painting and Coating.
 5. Dimensions: Fabricate continuous lengths with continuous fully welded seams and joints. Grind smooth all welds prior to painting. Shop prime and paint. Dimensions and location as noted on the Drawings.
 - a. Color as indicated in Section 09 90 00 – Painting and Coating.
 6. Fasteners: Tamper Resistant #10 x 2-inch, 18-8 Stainless Steel, flat head, star drive screw.
- E. Miscellaneous
1. Provide all other miscellaneous metal items and fastenings as noted or indicated on drawings. Requirements for galvanizing and coatings as specified on the Drawings apply to miscellaneous items.

2.04 MATERIAL HANDLING, DELIVERY, AND STORAGE

- A. Protection: Use all means necessary to protect miscellaneous metal materials before, during and after installation and to protect the installed work of other trades. Make no marks on architectural exposed metals during fabrication or erection.
- B. Keep protective plastic on pre-polished materials and factory finished window frames before and after installation.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 PREPARATION FOR EXECUTION OF WORK

- A. Inspection:
 - 1. Prior to all work of this Section, carefully inspect the installed work of all other trades affecting this work and verify that all such work is complete to the point where this installation may properly commence.
 - 2. Verify that all items to be attached to structural components, are in place, properly oriented, located and secured.
- B. Discrepancies: In the event of a discrepancy, do not proceed with the fabrication or installation until resolved by the Engineer.
- C. Installation: Mask wall prior to install. Adhere wall guard to painted wall with silicone caulk at perimeter, clean excess caulk in a workman like manner. Fasten per these specifications.

3.02 QUALITY ASSURANCE

- A. Material Specifications
 - 1. Obtain each type of material through one source from a single manufacturer.
 - 2. Material manufacturer shall provide material specifications for review by the Engineer.
- B. Field Measurements
 - 1. Take field measurements prior to preparation of shop drawings and fabrication where possible. Do not delay job progress; allow for adjustments during installation where taking field measurements before fabrication might delay Work.
- C. Shop Assembly
 - 1. Preassemble items in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

3.03 CLEANING

- A. Upon completion of installation, remove protective film and thoroughly clean stainless steel surfaces.
- B. Dispose of all waste materials legally.

3.04 PROTECTION

- A. Protect installed work as required by the quality standard to maintain product performance.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Wood framing.
 - 2. Wood supports.
 - 3. Wood blocking.
 - 4. Wood cants.
 - 5. Wood nailers.
 - 6. Wood furring.
 - 7. Wood grounds
 - 8. Wood sheathing.
 - 9. Wood subflooring
 - 10. Wood underlayment
 - 11. Plywood backing panels
 - 12. Building wrap

1.02 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product indicated.
 - 1. Include data for wood-preservative and fire retardant treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.
- B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.
- C. Research/Evaluation Reports: For the following:
 - 1. Treated wood.
 - 2. Engineered wood products.
 - 3. Foam-plastic sheathing
 - 4. Power-driven fasteners
 - 5. Power-actuated fasteners
 - 6. Expansion anchors
 - 7. Metal Framing anchors
 - 8. Building wrap
- D. Minutes of preinstallation conference.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

2.02 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive stained or natural finish, mark grade stamp on end or back of each piece
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
 - 4. Provide dry lumber with 19percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Wood Structural Panels:
 - 1. Plywood: DOC PS 1
 - 2. Oriented Strand Board: DOC PS 2.
- 3. Comply with "Code Plus" provisions in APA Foam No. E30K, "APA Design/Construction Guide: Residential & Commercial."

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP C2 (lumber) and AWP C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWP C31 with inorganic boron (SBX).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

- C. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.
 - 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.04 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
 - 2. Use treatment that does not promote corrosion of metal fasteners.
 - 3. Use Exterior type for exterior locations and where indicated.
 - 4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.05 DIMENSION LUMBER

- A. General: Of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Non-load-bearing Interior Partitions: Construction, Stud, or No. 2 grade and any of the following species
 - 1. Northern species; NLGA.
 - 2. Western woods; WCLIB or WWP.
- C. Framing Other Than Non-Load-Bearing Partitions: Construction or No. 2 the following species:
 - 1. Douglas-fir larch, Douglas-fir larch (north), or Douglas-fir south; NGLA, WCLIB, or WWP.
 - 2. Hem-fir or Hem-fir (north); NGLA, WCLIB, or WWP.
- D. Framing other than non-load-bearing partitions: Any species of machine stress-rated dimension lumber with a grade of not less than 2400f-2.0E

- E. Framing other than non-load-bearing-partitions: Any species and grade with a modulus of elasticity of at least 1,300,000 psi and an extreme fiber stress in bending of at least 850 psi for 2-inch nominal thickness and 12-inch nominal width for single-member use.
- F. Exposed Framing: Hand select material for uniformity of appearance and freedom from characteristics that would impair finish appearance.
 - 1. Species and Grade: As indicated above for load-bearing construction of same type.
 - 2. Species and Grade: Hem-fir or Hem-fir (north), Select Structural grade; NGLA, WCLIB, or WWPA.

2.06 TIMBER AND MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber for support or attachment of other construction, including the following:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Blocking.
 - 3. Cants.
 - 4. Nailers.
 - 5. Furring.
 - 6. Grounds.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Northern species, No. 2 Common grade; NLGA.
 - 2. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.07 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Composite of wood veneers with grain primarily parallel to member lengths, manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.
 - 1. Manufacturers:
 - a. Boise Cascade Corporation.
 - b. Georgia-Pacific Corporation.
 - c. Pacific Woodtech Corp.
 - d. Trus Joist MacMillan.
 - 2. Extreme Fiber Stress in Bending, Edgewise: 2850 psi for 12-inch nominal depth members.
 - 3. Modulus of Elasticity, Edgewise: 2,000,000 psi

- B. Wood I-joists: Prefabricated units complying with APA PRI-400; depths and performance ratings not less than those indicated.
 - 1. Manufacturers:
 - a. Boise Cascade Corporation
 - b. Georgia-Pacific Corporation
 - c. Pacific Woodtech Corp.
 - d. Trus Joist MacMillan.
 - 2. Web Material: Either oriented strand board or plywood, Exposure 1.
 - 3. Structural Capacities: Establish and monitor structural capacities according to ASTM D 5055.
 - 4. Trademark: Factory mark I-joists with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and I-joist compliance with APA standard.
- C. Rim Boards: Performance-rated product complying with APA PRR-401.
 - 1. Material: Mat-formed panels
 - 2. Thickness and Grade: 1-inch rim board
 - 3. Trademark: Factory mark with APA trademark indicating thickness, grade, and compliance with APA standard.

2.08 SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.
- C. Plywood Roof Sheathing: Exterior, Structural I sheathing.
- D. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.09 PLYWOOD BACKING PANELS

- 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 1/2-inch thick.

2.10 MISCELLANEOUS MATERIALS

- A. Fasteners:
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 2. Power-Driven Fasteners: CABO NER-272.
 - 3. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Manufacturers:
 - a. Alpine Engineered Products, Inc.
 - b. Cleveland Steel Specialty Co.
 - c. Harlen Metal Products, Inc.
 - d. KC Metals Products, Inc.
 - e. Silver Metal Products, Inc.
 - f. Simpson Strong-Tie Company, Inc.
 - g. Southeastern Metals Manufacturing Co., Inc.
 - h. United Steel Products Company, Inc.
 2. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
 3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Building Paper: Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- D. Building Wrap: Air-retarder sheeting made from polyolefins; cross-laminated films, woven strands, or spun-bonded fibers; coated or uncoated; with or without perforations; and complying with ASTM E 1677, Type I.
1. Manufacturers:
 - a. Celotex Corporation (The); Building Products Division
 - b. DuPont (E.I. DuPont de Nemours and Company).
 - c. Parsec, Inc.
 - d. Raven Industries, Inc.
 - e. Reemay, Inc.
 - f. Simplex Products.
 - g. Sto-Cote Products, Inc.
 - h. Tenneco Building Products.
 2. Thickness: Not less than 3 mils.
 3. Permeance: Not less than 10 perms.
 4. Flame-Spread Index: 25 or less per ASTM E 84.
 5. Allowable Exposure Time: Not less than three months.
- E. Building Wrap Tape: Pressure-sensitive plastic tape recommended by building wrap manufacturer for sealing joints and penetrations in building wrap.
- F. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.

- G. Sill Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- H. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. CABO NER-272 for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code.
 - 4. Table 2305.2, "Fastening Schedule," in the BOCA National Building Code.
 - 5. Table 2306.1, "Fastening Schedule," in the Standard Building Code.
 - 6. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in the International One- and Two-Family Dwelling Code.
- D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- E. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- F. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- G. Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above-referenced guide.

- H. Fastening Methods:

1. Combination Subfloor-Underlayment: Glue and nail to wood framing.
 2. Subflooring: Glue and nail to wood framing.
 3. Sheathing: Nail to wood framing.
 4. Underlayment: Nail to subflooring.
 5. Plywood Backing Panels: Nail or screw to supports.
- I. Apply building paper horizontally with 2-inch overlap and 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4-inch overlap.
- J. Building Wrap Application: Cover wall sheathing with building wrap as indicated. Cover upstanding flashing with 4-inch overlap. Seal seams, edges, and penetrations with tape.
- K. Apply sheathing tape to joints between sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION

SECTION 06 18 00

GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes framing using structural glued-laminated timber.
- B. Related Requirements:
 - 1. Division 06 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.03 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 3. For connectors. Include installation instructions.
- B. Shop Drawings:
 - 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
 - 2. Indicate species and laminating combination.
 - 3. Include large-scale details of member end geometry.
- C. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

1.05 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.
- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- C. Research/Evaluation Reports: For structural glued-laminated timber from ICC-ES.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed structural glulam timber construction similar in material, design, and extent to that indicated for this project and with a positive record of successful in-service performance and a minimum of 10 years experience.
- B. Manufacturer Qualifications: Provide factory-glued structural units produced by an AITC-or APA-EWS-licensed firm, with a minimum of 10 years experience.
- C. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.
- C. Store on level surface. Members shall be supported with blocking so spaced as to provide uniform and adequate support. Members shall be blocked well off the ground and at a well-drained location.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.
- B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.

- C. Seismic Performance: Structural glued-laminated timber and connectors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

2.02 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 2. Provide structural glued-laminated timber made from single species.
 3. Provide structural glued-laminated timber made from solid lumber laminations
 4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
 5. Adhesive shall not contain urea-formaldehyde resins.
 6. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Regional Materials: Glued-laminated timber shall be manufactured within 500 miles (800 km) of Project site from wood that has been harvested and milled within 500 miles (800 km) of Project site.
- C. Certified Wood: Glued-laminated timber shall be certified as "FSC Pure" 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."
- D. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch in grades needed to comply with "Performance Requirements" Article.
- E. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that complies with structural properties indicated.
- F. Species and Grades for Beams
1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E.
 2. Lay-up: Balanced.
- G. Appearance Grade: Framing, complying with AITC 110.
1. For Premium and Architectural appearance grades, fill voids as required by AITC 110.

2.03 PRESERVATIVE TREATMENT

- A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWP A U1, Use Category 1.
 - 1. Use preservative solution without substances that might interfere with application of indicated finishes.
 - 2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.
- B. Preservative: One of the following:
 - 1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
 - 2. Pentachlorophenol in light petroleum solvent.
 - 3. Copper naphthenate in a light petroleum solvent.
 - 4. Ammoniacal zinc copper arsenate (ACZA) in a water solution.
 - 5. Chromated copper arsenate (CCA) in a water solution.
 - 6. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
 - 7. Propiconazole tebuconazole imidacloprid (PTI) in a water emulsion.
- C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWP A M4 to surfaces cut to a depth of more than 1/16 inch (1.5 mm).

2.04 TIMBER CONNECTORS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or products that are approved as equal by substitution request.
- B. Fabricate beam seats as indicated.
- C. Fabricate arch base shoes as indicated.
- D. Fabricate beam hangers as indicated.
- E. Fabricate hinge connectors as indicated.
- F. Fabricate strap ties as indicated.
- G. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A 668/A 668M.
- H. Provide bolts with diameters as indicated, complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); nuts complying with ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- I. Provide shear plates with diameters as indicated, complying with ASTM D 5933.
- J. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M.
 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
- K. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness.
1. Primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- L. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M.

2.05 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- C. Sealers shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWP A M4.
1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.

- 2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.07 FACTORY FINISHING

- A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
 - 1. Color: As selected by Architect from manufacturer's full range.
- B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.
- C. Finishing materials shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.

- B. Framing Built into Masonry: Provide 1/2-inch (13-mm) clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches (76 mm); and do not embed more than 4 inches (102 mm) unless otherwise indicated.
- C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 3. Coat cross cuts with end sealer.
 - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- E. Install timber connectors as indicated.
 - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.03 ADJUSTING

- A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.04 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
 - 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wood Base.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry
- B. Section 09 90 00 – Painting and Coating

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For fabricator.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-1/2 inch to 1-foot.
 - 2. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
 - 3. Product data on lumber grade and plywood sheet goods.
- D. Sample: Submit three samples of each type of wood exposed to view:
 - 1. 12-inch long illustrating to include a finished end and mounting hardware.
- E. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As required by the Quality Certification Program for installation of the installed products to meet the Performance and Design Criteria.
- B. Materials shall be delivered to the job site in new, dry, unopened wrapping, clearly showing name of manufacturer and product.
- C. Store materials in a dry area, protected from weather, water and extreme humidity.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Dimensional lumber, nominal and actual, and wall base and miscellaneous trim. Carpentry items shop fabricated and finished in accordance with AWI/AWMAC/WI Architectural Woodwork standards.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Finish Carpentry Quality:
 - 1. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Custom Grade.
 - a. Premium Quality for all transparent finished material.
 - b. Typical: Custom Quality.

2.03 INTERIOR WOODWORK ITEMS

- A. Wood Base at Entry 101 and Break Room 102 as noted on the Drawings.
 - a. Species: VG Douglas Fir.
 - 1) Finger jointed material is not acceptable.
 - b. Size: Actual size 3/4-inch by 4-inch.
 - c. Grade: VG Clear.
 - d. Edge: Ease edges to 1/16-inch radius.
 - e. Moisture Content: Kiln Dried.
 - f. Surface to be Exposed: Surface Three Sides (S3S).
 - g. Lengths: Longest lengths possible with no piece being less than 4-feet.
 - h. Splicing: Tight fitting scarf joints.
 - i. Finish: Stained with clear finish per Section 09 90 00 – Painting and Coating.
- 1. Fasteners: Non-corrosive finish nails 2-1/2 times longer than the piece being fastened. Blowouts, tear outs and crushed wood due to overdriving fasteners in wood members from mechanical or manual fastening will be unacceptable.

2.04 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

- B. Interior Ceiling:
 - 1. Install continuous polyester non-woven vapor permeable scrim sheet to underside of structure at Utility 104 as indicated on the Drawings. Fasten with stainless steel staples. Material to be Class A, passing test ASTM E84.
 - a. Basis of Design: Benjamin Obdyke, Invisiwrap UV Black Housewrap.
 - b. Install 25 gauge, 7/8-inch hat channel with stainless steel fasteners perpendicular to structure as indicated on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the requirements of the quality standard specified before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with quality standard specified.

3.03 INSTALLATION

- A. General: Fabricate, assemble and finish all finish carpentry at the shop insofar as possible; construct units in sizes to permit convenient and efficient handling and installation; provide all items necessary for complete installation at the locations required. Machine all parts for precision fit and assemble with fastenings (pre-drill where necessary) and adhesives for permanently secure construction. Construct finish carpentry to true dimensions, square, level and plumb; verify all critical installation dimensions at the job site prior to fabricating items requiring close tolerance installation. Make accurate and tight joints; form to conceal shrinkage as far as possible; secure by gluing and fastening.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut to fit adjoining work. Refinish and seal cuts as recommended by quality standard.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 3. Install to tolerance of 1/8-inch in 96-inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.04 PROTECTION

- A. Protect installed work as required by the quality standard to maintain product performance, design criteria and warranty.

3.05 CLEANING

- A. Haul and dispose of all waste materials legally.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Cabinet units.
- B. Solid Surface Countertops.
- C. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry
- B. Section 06 20 00 – Finish Carpentry
- C. Section 09 90 00 – Painting and Coating

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 20 – Project Meetings.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For fabricator, and installer.
- C. Product Data: Provide data for hardware, accessories, and finishes.
- D. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Minimum Scale of Detail Drawings: 1-inch to 1-foot.
 - 2. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.
- E. Sample: Submit actual samples of Architectural cabinet construction, minimum 12-inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.

- F. Hardware Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- G. Manufacturer's Installation Instructions: For finishes and hardware. Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- H. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.05 QUALITY ASSURANCE

- A. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As required by the quality standard and fabricator for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Custom designed and fabricated casework made of laminates and painted substrates, associated accessories and hardware.

2.02 MATERIALS

- A. Cabinet Units:
 - 1. Construction:
 - a. Casework Construction Type: Type A - Frameless.
 - b. Interface Style for Cabinet and Door: Style 1 - Overlay; Full, unless detailed otherwise.
 - c. Layout for Cabinet and Door Fronts:
 - 1) All grades all styles of cabinetwork: Doors, drawer fronts and false fronts wood grain and laminate pattern to run and match vertically within each cabinet unit.
 - 2) Custom Grade: Doors, drawer fronts and false fronts wood grain and laminate pattern to run and match vertically within each cabinet unit.
 - 2. Wood-Based Materials:

- a. Hardwood Plywood: HPVA HP-1 Grade A; veneer core, type of glue recommended for application; of grain quality suitable for transparent finish.
 - b. Lumber: Maximum moisture content of 6 percent.
 - 3. High Pressure Decorative Laminate Materials:
 - a. Specification is based on products listed below.
 - 1) Comparable products by one of the following are also acceptable.
 - a) Formica Corporation: www.formica.com.
 - b) Panolam Industries International, Inc.
 - c) Nevamar: www.nevamar.com.
 - d) Or Approved Equal.
 - b. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
 - 1) Horizontal Surfaces: HGS, 0.048-inch nominal thickness.
 - 2) Vertical Surfaces: VGS, 0.028-inch nominal thickness.
 - 3) Flame Retardant Surfaces: HGF, 0.048-inch nominal thickness.
 - 4) Cabinet Liner: CLS, 0.020-inch nominal thickness.
 - 5) Laminate Backer: BKL, 0.020-inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
 - 6) Colors (Basis of Design):
 - a) Door/Drawer faces and edges: Formica, White Drops – 8824-58, matte.
 - c. Low Pressure Laminate (Melamine):
 - 1) Cabinet Liner: White.
 - 2) Substrate: Fire retardant MDF or particle board with Class A minimum rating.
- B. Solid Surface Countertops and Exposed Surfaces:
 - 1. Quality Standard: Type A, SSS30A homogenous sheet composed of a blend of natural minerals and 100 percent acrylic polymer (methyl methacrylate) complying with ANSI Z124.3 and Z124.6, Type 6.
 - a. Fire Rating: Class A.
 - b. Sheets: Book match sheets in sequential order and from the same batch for each item noted.
 - c. Adhesives: 100percent silicone sealant complying with ASTM C920 or neoprene-based panel adhesive.
 - d. Seams: Smooth, impenetrable, inconspicuous seams or serpentine seams with color matched adhesive, as required by industry fabrication standards.
 - e. Material: Solid Surface.
 - f. Thickness: 1/2-inch or 13mm.
 - g. Manufacturer and Color:
 - 1) SSM-1, Staron, Recycled Series, PG840 Pebble Gold.
 - a) Edge: Half bullnose, 1-1/2-inch profile.

C. Hardware:

1. Drawer Slides:
 - a. Basis of Design: Accuride International, Inc.
 - b. Performance Criteria:
 - 1) Rated extra heavy-duty grade for drawer size indicated.
 - 2) Drawer slides rated for 100 lbs minimum.
 - 3) Full extension.
 - 4) Self-close, stay closed feature.
2. Door and Drawer pulls:
 - a. Basis of Design: Amrock Bar Pull by Amrock
 - b. Performance Criteria:
 - 1) ADA Compliant.
 - 2) Finish: Sterling nickel.
 - 3) Length: 5-inch center to center.
3. Hinges:
 - a. Basis of Design: Sugatsune.
 - b. Acceptable manufacturers: Hafele, Salice, Blum or Approved Equal.
 - c. Features:
 - 1) Type: 110 degree opening Euro style concealed with soft closing feature.
 - 2) Finish: Satin Chrome
 - 3) Sizes: Refer to cabinet dimensions indicated on the Drawings.
4. Shelf Pins – Bracket Style:
 - a. Basis of Design: Hafele.
 - b. Performance Criteria:
 - 1) 1/4-inch diameter shank.
 - 2) Finish: Nickel plated steel.

2.03 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with fabricator's instructions.

3.03 INSTALLATION

- A. Install casework units as indicated, complete with all hardware and accessory items, pre-drilling where necessary; make plumb and level and securely attach to

adjoining construction. Adjust hardware and fittings for operation to the satisfaction of the architect; clean all exterior and interior surfaces and repair all damage to finishes. Leave the work free from defects and ready for the Owner's use, as approved at the time of final acceptance.

3.04 CLEANING

- A. Repair damaged and defective millwork where possible to eliminate defects functionally and visually; where not possible to repair, replace architectural millwork. Adjust joinery for uniform appearance.
- B. Clean architectural millwork on exposed and semi-exposed surfaces inside and out.
- C. Dispose of all waste material legally.

3.05 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, which ensures architectural millwork being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 07 19 10

WATER AND GRAFFITI REPELLENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including all Division 00 General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.02 SUMMARY

- A. This section includes requirements for surface preparation and application of the following:
 - 1. Graffiti-resistant coatings and films.
 - 2. Water repellent sealers for exterior concrete.
- B. Water and graffiti repellents are indicated with prefix **WGR** on the Drawings.

1.03 REFERENCES

- A. This section incorporates by reference the latest revisions of the following documents.
 - 1. Washington State Air Quality Rules and Laws:
 - a. Chapter 173-490 WAC Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC).
 - b. Chapter 70.94 RCW Washington Clean Air Act.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Samples: Provide graffiti-resistant film samples as part of Submittals requirements specified in glazing as stated elsewhere in the Contract Documents.
 - 2. Product Data: Provide product description. Include data substantiating that material is recommended by manufacturer for applications indicated.
 - a. Manufacturer's Installation Instructions, Maintenance Data: In accordance with Division 01 requirements.
 - 3. Test sample, and field inspection reports.
 - a. Installer Qualification Data: From manufacturer, indicating Applicator complies with requirements.
 - 4. Warranties: Samples of each manufacturer's warranties.
 - 5. Maintenance Materials: Provide extra materials for Project Representative's maintenance. Materials shall be same quality, model and manufacture as specified materials, in sealed unopened. Containers, with shelf life indicated and instructions for use. Verify quantities with Project Representative before delivery.

- a. Five gallons of each type of repellent and coating. One gallon of cleaner.
- b. One hand held applicator for each product.
6. Graffiti-Resistant Film for Glass: Ten percent of quantity installed.

1.05 MAINTENANCE MATERIAL

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. As required by Section 01 78 23 – Operations and Maintenance Data.

1.06 QUALITY ASSURANCE

- A. Applicator's Qualifications: Company specializing in performing the work of this Section approved by manufacturer, and employing experienced persons trained and approved by repellent manufacturer for application of materials and issuance of special warranty.

Graffiti-Resistant Plastic Film Installer Qualifications:

1. Single Installer with a minimum of 5-years demonstrated experience in installing products of the same type and scope as specified, and trained and approved by the manufacturer for products indicated.

1.07 TEST SAMPLES

- A. Prior to preparing mock-ups, obtain and test samples required by the manufacturer for laboratory evaluation in accordance with warranty requirements.
- B. Prepare and submit reports.

1.08 MOCK-UPS

- A. Prepare a representative surface 6-feet by 6-feet in size using specified materials.
- B. Demonstrate preparation and application of repellents and coatings on each type of surface, identical to those to be coated, to establish standards for workmanship and aesthetic effects.
 1. Indicate surface preparation procedures, coverage rates, application methods equipment.
- C. Notify Project Representative, 24 hours in advance of tests.
 1. Demonstrate materials and methods to be employed for the removal of spray paint, felt marker, lipstick, paint balls and grease on graffiti-resistant coatings.
 2. Cleaned surface of graffiti-resistant coatings shall be undamaged, and free of "shadows," "ghosts" or similar defects in appearance.
- D. Locate mock-ups where directed by Project Representative.
 1. Approved mock-ups may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in sealed, original, labeled containers bearing manufacturer's name, type of material, brand name, and instructions for mixing. Store materials off-ground, and under cover. Conform to additional manufacturer's written instructions regarding storage and handling of materials.

1.10 PROJECT CONDITIONS

- A. Weather and Substrate Conditions:
 - 1. Do not proceed with application of repellents and coatings when the following conditions exist, unless otherwise indicated in manufacturer's written instructions:
 - a. Ambient temperature is less than 40 degrees F or above 100 degrees F.
 - 2. When rain or temperatures below 40 degrees F are predicted for a period of 24 hours, or earlier than three days after surfaces become wet from rainfall or other moisture sources.
 - a. When substrate is frozen, or at surface temperature of less than 40 degrees F.
 - 3. When winds are sufficient to carry airborne chemicals to unprotected surfaces or adjacent properties, or would cause an improper application rate.
- B. Environmental Conditions: Provide adequate ventilation and safety precautions as recommended by coating manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Repellent and coating materials shall be compatible with substrate surfaces and other materials they are in contact with.
- B. Maximum VOC Content: Comply with referenced Washington State Air Quality Rules and Laws.
- C. Source Limitations: Obtain graffiti protection materials through one source from a single manufacturer.

2.02 NON-SACRIFICIAL GRAFFITI-RESISTANT AND WATER REPELLENT FOR EXTERIOR – WGR-1

- A. Description: RTV Silicone resin based penetrating type, maximum 250 g/L VOC content, colorless.
- B. Product:
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Chemprobe Technologies, Division of Tnemec Company, "Dur-A-Pell GS Series V626".
 - b. ProSoCo, Inc. "Blok-Guard & Graffiti Control Ultra 15".

- c. Professional Products of Kansas, Inc., "Professional Water Sealant and Graffiti Coating, Super Strength.
- d. Or Approved Equal.

2.03 SACRIFICIAL GRAFFITI-RESISTANT FILM FOR GLASS - WGR-4

- A. Description: Anti-vandal film composed of three layers of 2-mil polyester (PET) laminated together; optically clear, distortion-free, sacrificial coating, which when applied, provides a significant resistance to etching and scratching of underlying surface.
- B. Product:
 - 1. Vandal Shield, Graffiti Removals, Inc., "VS-1200".
 - 2. 3M, "Anti-Graffiti 6."
 - 3. Or Approved Equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator and manufacturer's authorized technical representative present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer, and that.
- B. Do not proceed with treatment application until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean surfaces of dirt, oils, efflorescence, mildew staining, and other contaminants in accordance with manufacturer's written instructions.
 - 1. Test surfaces for moisture content in accordance with manufacturer's written instructions. Allow damp or wet surfaces to dry.
- B. Remove contaminants using methods acceptable to repellent manufacturer and Project Representative.
 - 1. Notification Prior to Final Application: Notify Project Representative at least 24 hours in advance of performing work to witness final application. Clearly mark panels, which have received test applications.
- C. Protection of Surfaces:
 - 1. Protect adjoining work from spillage or overspray of repellents. Cover adjoining and nearby surfaces of aluminum, glass and planting where there is possibility of graffiti-resistant coatings being deposited on surfaces. Cover surface mounted items.
 - 2. Clean treatments from unintended surfaces immediately after spillage or overspray. Comply with manufacturer's recommendations for cleaning.

3. Cleaning materials and methods employed shall be such so as not to damage surfaces and permanent finishes.

3.03 APPLICATION

- A. Apply repellents in accordance with manufacturer's written instructions using low-pressure airless spray equipment.
 1. Ensure thorough saturation of porous surfaces of concrete and similar surfaces. Do not dilute or alter materials.
- B. Apply repellents at coverage rates and in number of coats determined on test applications.
 1. Apply treatment evenly until surfaces are fully wet, starting at the bottom and working up with a 6 to 8-inches rundown below the contact point of the spray pattern, unless otherwise recommended by repellent manufacturer.
- C. Finished surface to be even, uniform in texture and appearance, and free of runs and drips.
- D. Use brushes or rollers where spray method may damage adjacent surfaces.

3.04 GRAFFITI-RESISTANT FILM APPLICATION

- A. Preparation:
 1. Clean glass surfaces thoroughly prior to installation.Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Install film in accordance with manufacturer's instructions.
 1. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Engaged repellent manufacturer's factory-trained, authorized technical representative to perform field inspections and tests.
 1. Arrange for Project Representative and Applicator to be present during tests.
 2. Tests: Determine suitable application to each type of substrates before installation. Review substrate conditions, surface preparation procedures, coverage rates, application methods equipment. Notify Project Representative, 24 hours in advance of tests.
 3. Inspections During Application: Representative to be present during first day of application and periodically as recommended by manufacturer to

ensure compliance of quality of execution of manufacturer's written instructions, and acceptable to Project Representative.

- a. Review exposed substrates prior to application.
4. Prepare and submit inspection test reports, and coordinated in accordance with warranties.

3.06 PROTECTION OF FINISHED WORK

- A. Protect treated surfaces from traffic, rain, and other surface water in accordance with repellent manufacturer's written instructions.

3.07 CLEANING

- A. Remove and dispose of masking and protective materials.
- B. Remove over spray from adjacent surfaces with cleaner as according to repellent manufacturer's written cleaning instructions, and without damage to surfaces, as work progresses.
- C. Correct damage to work of other trades caused by water-repellent application, as approved by Project Representative.

3.08 SCHEDULE OF APPLICATIONS

- A. Graffiti Resistant Coatings:
 1. Apply to vertical surfaces within 8-feet of floor or grade where surfaces are accessible to the general public.
 2. When height of top of material or element exceeds 8-feet, extend material to top of the element up to a height of 12-feet.
- B. Water Repellents:
 1. Apply water repellents to surfaces above same areas indicated to receive graffiti resistant coatings and to other surfaces indicated, including surfaces exposed to rain.
 2. Unless otherwise indicated apply water repellents on concrete wall surfaces up to 4 feet above floor.
- C. Water Repellents for Exterior Traffic Surfaces and Interior Floor Surfaces, and as follows:
 1. Apply to surfaces as indicated.
 2. Do not apply repellents where traffic coatings are indicated.
- D. Glazing Films: Apply to glass surfaces as indicated.

END OF SECTION

SECTION 07 41 13

METAL ROOF AND WALL PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Prefinished Metal Roof and Wall Panels.

1.02 RELATED REQUIREMENTS

- A. Section 07 21 00 – Thermal Insulation
- B. Section 07 25 00 – Weather Barriers
- C. Section 07 62 00 – Sheet Metal Flashing and Trim
- D. Section 07 90 05 – Joint Sealers

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures.
Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
 - 1. Summary of test results, indicating compliance with specified requirements.
 - 2. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.
- D. Sample: For each roofing and wall system specified, submit samples of minimum size 12-inches square, representing actual roofing and wall metal, thickness, profile, color, and texture.
- E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- F. Warranty: Submit forms to have been completed in Owner's name with correct project address, name of project and type of building.
- G. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.

2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of roofing systems similar to those required for this project.
 1. Not less than 5 years of documented experience
 2. Accredited by IAS according to IAS AC472.
- B. Installer Qualifications: Company trained and authorized by roofing and wall system manufacturer and specializing in performing the work of this section with minimum 5-years experience.
- C. Mock-Up: Install at project site a mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color, texture and pattern and workmanship standard.
 1. Mock-Up Size: Two preformed metal roof / wall panel transitions complete with all clips, bent plates and caploc's and fixed connections as shown in the project drawings. Extend from wall to roof ridge to opposite base of wall.
 2. Incorporation: Mock-up may be incorporated into final construction upon approval by the Engineer.
- D. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements and mock up for review.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered in original packages, containers, or bundles showing manufacturers name and identifying marks. Protect all material from moisture damage before and after installation. Replace or repair all damaged material at no additional cost to the Owner.
- B. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.06 WARRANTY

- A. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant chalking, cracking, or peeling within specified warranty period of 20 year period from date of Substantial Completion.
- B. Contractor's Warranty: Warrant panels, flashings, sealants, fasteners and accessories against defective materials and/or workmanship, to remain watertight and

weatherproof with normal usage for two (2) years following Project Substantial Completion date.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Complete roofing and wall assemblies, including factory formed panels with factory applied finish roof and wall panels, clips, fasteners, connectors, and miscellaneous accessories, tested for conformance with performance criteria.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.
- B. Roof Covering External Fire-Resistance Classification: UL 790 Class A.
- C. Wind Uplift: Class 90 wind uplift resistance of UL 580 and ASTM E1592.
- D. Impact Resistance: UL 2218 impact test standard.
- E. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
- F. Provide continuity of thermal barrier at building enclosure elements and continuity of air barrier and vapor retarder seal at building enclosure elements in conjunction with materials specified in Section 07 25 00 – Weather Barriers.
- G. Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
- H. Fabricate and finish continuous roof/wall panels and accessory items at factory, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- I. Factory-install captive gaskets, sealants, or separator strips at panel joints to provide weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.03 METAL ROOF AND WALL PANELS

- A. MP-1 as noted for Roof Panels, MP-2 as noted for Wall Panels on the Drawings.
- B. Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792, Class AZ50 coating designation; structural quality. Smooth surface texture;

continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating in a continuous length from roof ridge to bottom of wall as indicated on the drawings.

1. Features:
 - a. Sheet Thickness: 22-gauge.
 - b. Alloy: Galvalume steel sheet conforming to ASTM A792, AZ50.
 - c. Finish: Fluoropolymer Coating System: Manufacturer's standard multi-coat thermocured coating system, including minimum 70 percent fluoropolymer color topcoat with minimum total dry film thickness of 0.9 mil.
 - d. Profile: Standing Seam.
 - e. Seam Height: 1-inch.
 - f. Panel Coverage: 16-inches.
 - g. Pan Type: Flat Pan.
 - h. Color: Manufacturer's Dark Bronze.
2. Panel Fabrication Requirements:
 - a. General: Comply with the dimensions, profile limitations, gages and fabrication details; and, to the extent not detailed, provide the manufacturer's standard panels to configure as needed in the field.
 - b. Performance: Fabricate components and assemble units to comply with the performance requirements specified for the completed installation of the Work.
 - c. Panel to run full length of high wall, roof and low wall with no seams.
 - d. Caploc seam location as indicated in the Drawings.

2.04 MANUFACTURERS

- A. Specification is based on The Breyer Company: TBC Caploc, 119 Clay Street NW, Auburn, WA 98001, (253) 735-1824 - contact Peter Tuininga, petert@thebryercompany.com profile and standard finish.
 1. Comparable products by one of the following are also acceptable.
 - a. Nu Ray Metals: NRM 1000.
 - b. AEP Span hp Meal Roofing.
 - c. Or Approved Equal.
 2. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.

2.05 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Caploc Batten: Provide roofing panel manufacturer's approved caploc batten profile over integral panel seams with metal roof panel manufacturers approved clip. Construct caploc to match roof panels, procured from the same supplier. Fabricate in longest lengths possible for continuous material installation with tight mitered corners with sealant as required for a watertight installation.
- C. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels as provided by the roof and wall panel manufacturer.

- D. Underlayment: In accordance with Section 07 25 00 — Weather Barriers and per the Drawings.
- E. Sealants: As specified in Section 07 90 05 — Joint Sealers.
 - 1. Exposed sealant must cure to rubber-like consistency.
 - 2. Concealed sealant must be non-hardening type.
- F. Batten Closures: Provide manufacturer's prefabricated, close-fitting components of same material and finish as roof panels. Manufacturer to provide continuous lengths of battens for installation with mitered corners at the high end, ridge, and low end of the roof, with sealant as required for a watertight installation. See Drawings for additional information.
- G. Miscellaneous Secondary Framing: Light gauge steel framing incidental to structural supports; fabricated from steel sheet.
 - 1. Profile: Manufacturer's standard profile for conditions present.
 - 2. Material: As required for material compatibility with panel sheet material.
- H. Attachment:
 - 1. Nailers: Provide horizontal and vertical wood nailers and stainless steel fasteners as indicated on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Roof panels are to be installed in full, continuous lengths, up the high wall, down the roof, and down the low wall with no seams.
- C. Anchor component parts of the preformed metal roofing panels securely in place, providing for necessary structural movement.
- D. Tolerances: Erect the Work plumb, level, and true to line with tolerances not exceeding 1/4 inch in runs of 20 feet.
- E. Fasteners: Provide a concealed-fastener installation system, with no fasteners exposed on the exterior faces of the Work.

- F. Sealants or Gaskets: Install sealants or gaskets for preformed metal roofing panel Work as indicated and as required for performance. Gaskets, if used, shall be as recommended by the preformed metal roofing panel manufacturer.
- G. Coordinate with installation of associated counterflashing's and other components installed under other sections.
- H. Damaged Material: Remove and replace panels and component parts of the Work (including finish) which have been damaged beyond successful repair, as directed by the Engineer.

3.04 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.
- B. Dispose of all waste material legally.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria, finish and warranty.

END OF SECTION

SECTION 07 46 23

WOOD SIDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wood TG Siding.
- B. Wood TG Soffit.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry
- B. Section 07 21 00 – Thermal Insulation
- C. Section 07 25 00 – Weather Barrier
- D. Section 07 62 00 – Sheet Metal Flashing and Trim

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
- C. Supporting literature that states that material is sourced and harvested responsibly and sustainably and complying with the LACEY Act and IBAMA.
- D. Shop Drawings: Indicate required flashings, sealing at openings.
- E. Sample: Submit two samples 24-inch long samples of all siding profiles noted in the specifications in size illustrating surface texture and grain. Samples should be representative of final finish of each type of siding indicated.
- F. Maintenance Data: For users' operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.04 MAINTENANCE MATERIAL

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

- B. As required by Section 01 78 23 – Operations and Maintenance Data.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience of projects in similar size and scope.
- B. Material Sourcing: Material to be sourced from a yard or manufacturer that can demonstrate compliance with the LACET Act and the standards set by international agencies such as IBAMA.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in covered ventilated areas with constant minimum temperature of 60 degrees F and maximum relative humidity of 55 percent.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Wood siding and soffit as noted on the Drawings.

2.02 EXTERIOR WOODWORK ITEMS

- A. Wood TG Siding.
1. TG Boards: Tigerwood as defined by the Wood Database, www.wood-database.com.
 - a. Species: Astronium spp. (A. graveolens and A. fraxinifolium)
 - b. Size: Nominal 1-inch by 6-inch
 - c. Edge: Tongue and groove with eased edge. Chamfered edges are unacceptable.
 - d. Moisture Content: Air dried or Kiln Dried.
 - e. Surface to be Exposed: Surface Four Sides (S4S)
 - f. End Grain Sealer: Site applied non-toxic wax emulsion to exposed end grain prior to installation.
 2. Site Finishing: Continuous lengths as noted on the Drawings.
 3. Outside Miters: Thoroughly wipe each freshly cut mitered board and biscuit slot with acetone just prior to applying glue and biscuit. Adhere with biscuit size 0 and Type III wood glue. Follow manufacturer's instructions for glueing and clamping. Provide a continuous vertical tight joint at outside miter, no gaps or misaligned pieces will be acceptable.
 4. Inside Miters: Thoroughly wipe each freshly cut mitered board with acetone just prior to applying glue. Adhere with Type III wood glue. Follow manufacturer's instructions for glueing and clamping. Provide a continuous vertical tight joint at inside miter, no gaps or misaligned pieces will be acceptable.
 5. Fasteners: Stainless Steel finish nails that are 2.5 times the thickness of the board being applied. Visible blowouts and tear outs in members will be unacceptable.

- B. Wood TG Soffit
 - 1. TG Boards: Tigerwood as defined by the Wood Database, www.wood-database.com.
 - a. Species: Astronium spp. (A. graveolens and A. fraxinifolium)
 - b. Size: Nominal 1-inch by 6-inch
 - c. Edge: Tongue and groove with eased edge. Chamfered edges are unacceptable.
 - d. Moisture Content: Air dried or Kiln Dried.
 - e. Surface to be Exposed: Surface Four Sides (S4S)
 - f. End Grain Sealer: Site applied non-toxic wax emulsion to exposed end grain prior to installation.
 - 2. Site Finishing: Continuous lengths as noted on the Drawings.
 - 3. Fasteners: Stainless Steel finish nails that are 2.5 times the thickness of the board being applied. Blowouts and tear outs in timbers will be unacceptable.
- C. Shop Finishing:
 - 1. Finish Work in accordance with Section 09 90 00 – Painting and Coating.
 - a. Clear finish:
 - 1) Color: See Drawings and Schedule, 09 90 00 – Painting and Coating
 - 2) Preparation: As noted in Section 09 90 00 – Painting and Coating.
 - 3) Sheen: As noted in Section 09 90 00 – Painting and Coating.

2.03 ACCESSORIES

- A. Exterior:
 - 1. Vertical and horizontal wood nailers and stainless steel fasteners as noted on the Drawings.
 - 2. Insect Screen: Stainless steel Number 10 mesh (.0787-inches), standard weave, location as indicated on the Drawings. Install with stainless steel staples.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are dry and ready to receive work.
- B. Verify that water-resistive barrier has been installed over substrate completely and correctly per Section 07 21 00 – Thermal Insulation and Section 07 25 00 – Weather Barriers.
- C. Do not begin Work until unacceptable conditions have been corrected.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with these specifications and as noted on the Drawings based on conditions present.
- B. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- C. Fasten siding in place, level and plumb.
- D. In all areas other than those with painted graphics, siding is to be left clean and clear, with no fillers, coatings or residue that would inhibit, stain or damage natural patination from weathering.

3.04 TOLERANCES

- A. Maximum variation from Plumb and Level: 1/4-inch per 10-feet.
- B. Maximum offset from Joint Alignment: 1/16-inch.

3.05 PROTECTION

- A. Protect installed products from damage from weather and other causes during remainder of the construction period.

3.06 ADJUSTING

- A. Repair or replace damaged vertical siding caused from damage during construction.

3.07 CLEANING

- A. Leave premises clean of debris and residue resulting from work of this Section.
- B. Haul and dispose of all waste materials legally.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items.

1.02 RELATED REQUIREMENTS

- A. Section 07 41 13 – Metal Roof and Wall Panels
- B. Section 07 46 23 – Wood Siding
- C. Section 07 90 05 – Joint Sealers

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For fabricator.
- C. Shop Drawings: Indicate material profile, jointing locations, jointing details, fastening methods, flashings, terminations, and installation details.
- D. Samples:
 - 1. Finish Sample: Submit two samples illustrating each metal finish color.
 - 2. Fabrication Sample: Submit sample of coping lap joint as it will occur every 10-feet.
- E. Warranty: Submit manufacturer finish warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.
- B. Comply with the applicable recommendations contained in "Architectural

Sheet Metal Manual," latest revision, of the Sheet Metal and Air Conditioning Contractors National Association, Inc., in addition to complying with pertinent codes and regulations and ASTM standards.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in original packages, containers, or bundles showing brand name and identifying marks. Protect all material from moisture damage before and after installation. Replace or repair all damaged material at no additional cost to the Owner.
- B. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.07 WARRANTY

- A. Manufacturer's Finish Warranty: Correct defective work within a 20 year period after Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
 - 1. Panel Finish Criteria are listed AAMA 2605.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Sheet metal fabricated into items such as flashings, counterflashings, base flashing at grade, and other items indicated and scheduled.
- B. Metal Flashing: Unless otherwise noted all exposed exterior sheet metal flashing and trim is pre-finished fluoropolymer coated sheet steel.

2.02 MATERIALS

- A. Steel Sheet not exposed to view: Zinc-coated (galvanized) steel sheet complying with ASTM A 653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792, Class AZ50 coating designation; structural quality. Smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating:
 - 1. Fluoropolymer Coating: ASTM A526, 20-gauge thick sheet metal with 1.25 oz./sq.ft. galvanized with Kynar 500, Hylar 5000, finish Or Approved Equal.
 - 2. Color: Sterling Gray – SRI-44, standard Kynar color.
- B. Flashing and trim exposed to view: Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792, Class AZ50 coating designation; structural quality. Smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating

and on panel back with specified panel back coating:

3. Fluoropolymer Coating: ASTM A526, 20-gauge thick sheet metal with 1.25 oz./sq.ft. galvanized with Kynar 500, Hylar 5000, finish Or Approved Equal.
 4. Color: Dark Bronze – SRI-27, standard Kynar color or metal roof and wall panel manufacture's matching color.
- C. Stainless Steel: for all other uses: ASTM A 666 Type 304, rollable temper, 20-gauge thick; smooth No. 4 finish.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- D. Fabricate vertical faces with bottom edge formed outward 1/4-inch and hemmed to form drip.

2.04 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Fasteners.
 1. Fasteners for use with metal flashing or sheet metal items shall be manufactured or coated with the same metal/color as the flashing.
 2. Pop-rivets, screws, bolts, nuts and washers shall be of the type and size recommended by the manufacturer or specified as a component of an approved system. They shall be coated or plated with a corrosive resistant material either prior to or after installation.
 3. Sealants shall be single component, gun grade, Dow-Corning 781, SikaDur, Sikaflex, Or Approved Equal, color to match.
- C. Flexible Flashings.
 1. See 07 25 00 – Weather Barriers, for additional information.
- D. Slip Sheet: Rosin sized building paper.
- E. Protective Backing Paint: See Section 09 90 00 - Painting and Coating.
- F. Sealant: As specified in 07 90 05 – Joint Sealers.

- G. Solder: ASTM B32 – 08: Standard Specification for Solder Metal.
- H. Flux: Raw muriatic acid. Wash off thoroughly immediately after soldering.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 ADJUSTING

- A. Adjust and lubricate hardware for proper operation.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.06 SCHEDULE

- A. Unless otherwise noted all exposed exterior sheet metal flashing and trim is pre- finished fluoropolymer coated sheet steel.
- B. At Grade Flashings: Foundation insulation protection.
 - 1. Material: Prefinished Sheet Steel.
 - 2. Thickness: 20 gauge/0.080 inches.
 - 3. Seaming: Butt joint with concealed splice plates.
 - 4. Corners: Fully-welded shop fabricated corners, ends and intersections.
- C. Counter Flashing:
 - 1. Material: Stainless Sheet Steel.
 - 2. Thickness: 20 gauge/0.080 inches.
 - 3. Seaming: Butt joint with concealed splice plates.
 - 4. Corners: Fully-welded shop fabricated corners, ends and intersections.
- D. Cap, Sill and Ledge flashings:
 - 1. Material: Prefinished Sheet Steel.
 - 2. Thickness: 20 gauge/0.080 inches.
 - 3. Seaming: Butt joint with concealed splice plates if over 8-feet in length.

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4. Corners: Fully-welded shop fabricated corners, ends and intersections.
 5. Color to match roofing.
- E. Door Head Flashing, Entry 101.
1. Material: Prefinished Sheet Steel.
 2. Thickness: 20 gauge/0.080 inches.
 3. Seaming: Butt joint with concealed splice plates of pieces no less than 8 feet.
 4. Corners: Fully-welded shop fabricated corners, endcaps and intersections.
 5. Color to match roofing.
- F. Window/Louver Head Flashing, Breakroom 102, Restroom 103.
1. Material: Prefinished Sheet Steel.
 2. Thickness: 20 gauge/0.080 inches.
 3. Seaming: Butt joint with concealed splice plates of pieces no less than 8 feet.
 4. Corners: Fully-welded shop fabricated corners, endcaps and intersections.
 5. Color to match roofing.
 6. Window and Louver Surround: coordinate with details and specifications.
- G. Roof Flashings:
1. Material: Prefinished Sheet Steel.
 2. Thickness: 20 gauge/0.080 inches
 3. Seaming: Butt joint with concealed splice plates.
 4. Corners: Fully-welded shop fabricated corners, ends and intersections.
 5. Color to match manufacturer's roofing color.

END OF SECTION

SECTION 07 90 05

JOINT SEALERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Sealants for exterior surfaces.
- B. Sealants for interior surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 06 20 00 – Finish Carpentry
- B. Section 06 41 00 – Architectural Wood Casework
- C. Section 07 41 13 – Metal Wall and Roof Panels
- D. Section 07 62 00 – Sheet Metal Flashing and Trim
- E. Section 08 11 13 – Hollow Metal Doors and Frames

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Preliminary Selection Sample: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Field Samples for Confirmation: provide sealant samples in the color selected based on Manufacturer's charts for sealants other than the ones included in the Visual and Performance Mockup. Field samples shall be minimum 12 inches long and installed at joints intended for each particular sealant use. Mockup and field samples will be used to confirm sealant color selection.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.

- G. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- H. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- I. Field Test Report Log: For each elastomeric sealant application.
- J. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- L. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommendations on maintenance schedule.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5 years of experience.
- B. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project. Minimum 5 years of documented experience in facilities of this size and scope.
 - 1. Prequalification of single source installers for exterior sealants is encouraged.
- C. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- D. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. 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.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
 5. Confirm compatibility with water repellents and cleaners.
- E. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 5. Provide staining report for sealant and project substrates.
- F. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
1. Contractor and Owner's representative together shall locate test joints on the project.
 2. Manufacturer's representative to conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of nonelastomeric sealant and joint substrate indicated.
 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 5. Prepare a written report as to whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

7. Record test locations on Project Record Documents.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.06 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric 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: Ten (10) years from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Joint sealers for properly designed joints in interior and exterior materials; selected for durability, movement capacity, adhesion to substrates and non staining characteristics.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants As selected by Architect from manufacturer's full range for each location.
- C. Elastomeric Sealants: Comply with ASTM C 920 and other requirements

indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- D. Stain-Test-Response Characteristics: Where elastomeric 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.

2.03 MATERIALS

A. Sealants for exterior surfaces:

1. (S-1): Silyl-terminated polyether elastomeric; ASTM C 920, Grade NS, Class 25, Uses NT, M, G, A and O; single, or multi- component.
 - a. Color: Standard and custom colors matching finished surfaces.
 - b. Product: Sonolastic 150 and 150 tint base manufactured by Sonneborn.
2. (S-2): Silicone Sealant: ASTM C 920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, general purpose, medium modulus, neutral curing, non- sagging, non-staining, non-bleeding.
 - a. Movement Capability: +/- 50 percent.
 - b. Color: Standard colors matching finished surfaces.
 - c. Product: 795 manufactured by Dow Corning.
 - d. Designed for weather-proofing typical exterior materials including unprimed adhesion to anodized and fluoropolymer coated aluminum.
3. (S-3): Surface Modified Silicone Sealant: ASTM C 920, Grade NS, Class 50, Uses NT, A, G, M, O; single component, general purpose, medium modulus, neutral curing, non-sagging, non-staining, non-bleeding.
 - a. Movement Capability: +/- 50 percent.
 - b. Color: Standard colors matching finished surfaces.
 - c. Product: 756 manufactured by Dow Corning.
 - d. Designed for weather-proofing sensitive porous stone and light colored metal panel substrates.
4. (S-4): Butyl Sealant: ASTM C 920, Grade NS, Class 12-1/2, Uses NT, M, A, G, O; single component, solvent release, non-hardening, non-drying, non-skinning, non-sagging.
 - a. Movement Capability: Plus and minus 12-1/2 percent.
 - b. Shore A Hardness Range: 10 to 30.
 - c. Product: SikaLastomer-511 by Sika.
 - d. Designed for concealed joints requiring non-drying sealant like lap joints in sheet metal flashing and trim.
5. (S-6): Preformed Compressible Foam Sealers.
 - a. Movement +25%, -25% (50% total) - permanently elastic.
 - b. Color: Color as selected to match concrete.
 - c. Product: THC 900-901 by Tremco Inc.
 - 1) Backerseal by Emseal.
 - 2) illmod 600 by Tremco Inc.

B. Sealants for interior surfaces:

1. (S-10): General Purpose Interior Sealant: polyurethane; ASTM C 920, Grade NS, Class 25, Uses NT, M, G, A and O; single, or multi-component, paintable.
 - a. Color: Standard colors matching finished surfaces.
 - b. Product: Dymonic FC, Dymeric 240FC by Tremco Inc.
 - c. Designed for interior movement and non-moving joints adjacent to painted surfaces.
2. (S-11): Tile Sealant: Silicone; ASTM C 920, Uses M and A; single component, mildew resistant.
 - a. Colors other than white may be required.
 - b. Product: Trade Mate Tub, Tile & Ceramic Silicone Sealant manufactured by Dow.
3. (S-12): Acoustical Sealant: Butyl or acrylic sealant; ASTM C 920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non- skinning.
 - a. Product: Tremco "Acoustical Sealant".
 - b. Tested as part of acoustical assemblies.
4. (S-13): Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Grade P, Class 25, Uses T, M and A; single or multi- component.
 - a. Approved by manufacturer for wide joints up to 1-1/2 inches.
 - b. Color: Standard colors matching finished surfaces.
 - c. Product: Vulkem 45 SSL by Tremco Inc.
 - d. Designed for exposed, trafficked joints with pourable self-leveling installation.

2.02 ACCESSORIES

A. Joint sealant backing:

1. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
2. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) 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:
3. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
4. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint- filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

- B. Miscellaneous Materials:
 - 1. 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.
 - 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
 - 3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
 - 4. Natural Sand: Washed natural sand containing no contaminants that would affect the sealant. Color as approved by the architect for sanded joints as indicated or scheduled.
- C. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 CLEANING

- A. Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.06 SCHEDULE

- A. Sealants for exterior surfaces.
 - 1. (S-1): Exterior joints occurring in paintable surfaces.

2. (S-2): Typical exterior weather-proofing joints including metal to metal, metal to glass and perimeters.
 3. (S-3): Exterior weather-proofing joints including porous unit masonry, and concrete applications.
 4. (S-3a): Exterior weather-proofing joints at ledger angles in masonry veneer. Sand appearance to match brick mortar appearance. Matching may require several iterations.
 5. (S-4): Concealed sealants in sheet metal flashing, metal work and other joints calling for nonhardening, nonskinning, non-drying, nonmigrating sealant.
 6. (S-6): Used as a secondary sealant behind directly-applied liquid sealant. Use at all joints larger than 3/4 inch in width as a secondary sealant.
- B. Sealants for interior surfaces:
1. (S-10): Typical Interior Sealant: moving and non-moving Interior wall and ceiling control joints, smoke rated (but not fire rated) partitions.
 2. (S-11): Joints between plumbing fixtures and floor and wall surfaces. Joints between kitchen, laundry room and bath countertops and wall surfaces.
 3. (S-12): Use for concealed locations only. Sealant bead between top stud runner and structure and between bottom stud track and floor at any wall designated as acoustical.
 4. (S-13): Control joints in floors.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

2.01 SECTION INCLUDES

- A. Non fire rated steel doors.
- B. Non fire rated steel frames.
- C. Exterior steel doors.
- D. Exterior steel frames.

2.01 RELATED REQUIREMENTS

- A. Section 07 46 23 – Wood Siding
- B. Section 08 71 00 – Hardware
- C. Section 09 21 16 – Gypsum Board Assemblies
- D. Section 09 90 00 – Painting and Coating

2.01 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes. Include U-value data for thermally broken doors and frames.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

2.01 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

2.01 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.
- B. As required by SMACNA Guideline Chapter 3 and Section 01 50 00 – Temporary Facilities and Controls.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide doors and frames by one of the following:
 - 1. American Steel Products Inc.
 - 2. Amweld Building Products, LLC
 - 3. Ceco Door Products
 - 4. Curries Company
 - 5. National Custom Hollow Metal Doors & Frames
 - 6. Pioneer Industries, Inc.
 - 7. Security Metal Products Corp.
 - 8. Steelcraft
 - 9. Therma-Tru Corp.
 - 10. Or Approved Equal

2.01 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, CS (commercial steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, CS (commercial steel), Type B.
- C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, CS (commercial steel), Type B; with G60 zinc (galvanized) or A60 zinc-iron alloy (galvannealed) coating.
- D. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, zinc coat according to ASTM A 153/A 153M, Class C or D as applicable.

2.02 FRAMES

- A. Fabrication – Interior Frames: Fabricate frames of full-welded unit construction, with corners mitered, reinforced, and continuously welded full depth and width of frame. Knockdown frames are not acceptable.
 - 1. For interior use, form frames from cold- or hot-rolled steel sheet of the following thicknesses:
 - a. Openings up to and including 48-inches Wide: 0.0598-inch.
 - b. Openings More Than 48-inches Wide: 0.0747-inch.
 - 2. Frame Metal Thickness: 16-gauge.

3. Hollow metal jams and header shall be filled with mineral wool. Fill material to be coordinated with construction sequencing.
 - a. 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.
- B. Fabrication – Exterior Frames:
 1. Frame Metal Thickness: 14 gauge.
 2. Fabricate frames as welded unit type. Kerf frames for exterior doors.
 3. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
 4. Prepare frame for silencers as required in the Section 08 70 00 – Door Hardware.
 5. Provide internal blank data/power conduits in header and each jamb to a latch-height, with blank connection caps at latch box, hinge jamb and each header corner.
- C. Shop Priming.
 1. Clean, treat and paint surfaces of fabricated hollow metal units including galvanized surfaces, whether concealed or exposed in the finished work.
 2. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before the application of the shop coat of paint.
 3. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC- PT2), hot phosphate solution (SSPC-PT4) or basic zinc chromate-vinyl butyl solution (SSPC-PT3).
 4. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 2.0 mils.
 5. For all frames, in addition to prime coat, apply one coat of asphalt emulsion undiluted, to all concealed surfaces of frames; no exceptions.
- D. Field Finish: Paint frames in a controlled environment under provisions of Section 09 90 00 – Painting and Coating.
- E. Anchors: Use manufacturer's standard jamb anchors or as indicated on drawings. (Use minimum 4 anchors per jamb.)
 1. Jamb Anchors: Weld jamb anchors to frames near hinges and directly opposite on strike jamb as required to secure frames to adjacent construction.
 2. Stud Partitions: Insert type with notched clip to engage stud, welded to back of frames, formed of same material as frame, not less than 0.042-inch thick. Provide at least the number of anchors for each jamb according to the following heights:
 - a. Three anchors per jamb up to 60 inches in height.
 - b. Four anchors per jamb from 69 to 90 inches in height.
 3. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material as frame, 0.067-inch thick, as follows:
 4. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive

fasteners, welded to bottom of jambs and mullions.

- F. Hardware Reinforcement: Fabricate from same material as frame. Minimum thickness of steel reinforcing plates for the following hardware:
 - 1. Hinges and Pivots: 0.167-inch thick by 1-1/2 inches wide by 6-inches longer than hinge, secured by not less than 6 spot welds.
 - 2. Strike, Flush Bolts, and Closers: 0.093-inch.
 - 3. Surface-Mounted Hold-Open Arms and Panic Devices: 0.093-inch.
- G. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.
- H. Rubber Door Silencers: Except on weather-stripped doors, drill stop in strike jamb to receive three silencers on single-door frames and drill head at strike side to receive two silencers on double-door frames. Install plastic plugs to keep holes clear during construction.

2.02 STEEL DOORS

- A. Exterior Doors:
 - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
 - 2. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, with manufacturer's standard coating thickness.
 - 3. Thermal-Rated (Insulated) Doors: For exterior doors enclosing conditioned space provide doors fabricated with thermal-resistance value (R-value) to meet energy code requirements when tested according to ASTM C 1363.
- B. Interior Doors, Non-Fire-Rated:
 - 1. Grade: ANSI A250.8 Level 1, physical performance Level C, Model 1, full flush.
- C. Panels: Same construction, performance, and finish as doors.

2.03 DIMENSIONING

- A. Verify opening sizes, exact wall materials and partition thickness prior to frame fabrication.
- B. Fabricate work to provide the following edge clearances:
 - 1. Provide beveled edges 1/8-inch in 2-inch or both vertical edges of doors.
 - 2. Provide 1/8-inch between doors and frames at head and jambs.
 - 3. Provide 1/8-inch at meeting edges of pairs of doors.
 - 4. Provide 1/8-inch door-to-stop clearance.
 - 5. Provide 3/4-inch maximum between door and sills where no threshold is used; 1/4-inch above carpeting.
 - 6. Provide 3/8-inch maximum between door and sills where threshold is used.

2.04 STOPS AND MOLDINGS

- A. Provide stops and moldings around solid, glazed, and louvered panels where indicated.
- B. Form fixed stops and moldings integral with frame, unless otherwise indicated.
- C. Provide removable stops and moldings where indicated or required, formed of 0.032-inch thick steel sheets matching steel frames. Secure with countersunk flat or oval head machine screws spaced uniformly not more than 12-inches o.c.. Form corners with butte hairline joints.
- D. Coordinate rabbet width between fixed and removable stops with type of glass or panel and type of installation indicated.

2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for cleaning, treating, priming, and when specified, finishing.
- B. Finish products specified in this Section after fabrication.

2.06 STEEL SHEET FINISHES

- A. 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, complying with SSPC-SP 3, "Power Tool Cleaning", or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistence to provide a uniform dry film thickness of not less than 0.7 mils.
 - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with ANSI A224.1 acceptance criteria; compatible with substrate and filed-applied finish paint system indicated; and providing a sound foundation for filed-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.
- B. Coat inside of frames to be installed in masonry, with bituminous coating, prior to installation.
- C. Coat inside of other frames with bituminous coating to a thickness of 1/16-inch.

3.03 INSTALLATION

- A. All adhesives, sealants, paints and coating applied on site must comply with the VOC limits and Submittal requirements for IEQ 4.1: For adhesives and sealants. IEQ 4.2 For Paints and Coatings, and IEQ 4.3 For Flooring and Systems (wall base) as specified in Section 013515 - LEED Certification Procedures.
- B. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- C. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- D. Install fire rated units in accordance with NFPA 80.
- E. Seal seam at top closures after finish is applied to create a smooth surface without groove or pits.
 - 1. Seal with sealant per Section 07 90 05 - Joint Sealers.
- F. Pack all frames with insulation as noted these specifications
- G. Coordinate installation of hardware.
- H. Coordinate installation of electrical connections to electrical hardware items.
- I. Touch up damaged factory finishes.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.

3.05 ADJUSTING

- A. Adjust and lubricate hardware for proper operation.
- B. Adjust for smooth and balanced door movement in accordance with manufacturer's instructions.

3.06 CLEANING

- A. Dispose of all waste material legally.

3.07 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.08 SCHEDULE

- A. Refer to door schedule on the Drawings.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract.

1.02 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory or shop machining for hardware.
- B. Related Requirements:
 - 1. Section 06 20 00 – Finish Carpentry
 - 2. Section 08 71 00 – Door Hardware
 - 3. Section 09 90 00 – Painting and Coating

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: For each type of door. Include details of core and edge construction and trim for openings.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body when FSC certified wood is specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package factory finished wood veneer doors individually in plastic bags or cardboard cartons.
- C. Package factory primed wood veneer doors with factory standard paper or cardboard slip sheets between each individual door leaf.
- D. Mark each door on the top rail with the opening number, door handling, and door construction, including face veneer type used on Shop Drawings. Do not apply any information to the bottom rail.

1.06 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, 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.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity as required during the remainder of construction period.

1.07 WARRANTY

- 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-inch by 84-inch section of a 1.75-inch thick door.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Solid core wood doors.

2.02 MANUFACTURERS

- A. Oregon Door.
- B. Cleary Millwork.
- C. Simpson Door Company.
- D. Beacon Metals, Inc.
- E. Or Approved Equal.
- F. Source Limitations: Obtain flush wood doors from single manufacturer.

2.03 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- B. Regional Materials: When feasible, flush wood doors 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. WDMA I.S.1-A Performance Grade: Standard Duty.
 - 1. All doors must meet specified WDMA performance duty level, including

face screw holding requirement. Surface applied hardware shall be installed with screws; through-bolts are not acceptable.

- D. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide solid wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 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.

2.04 DOORS FOR CLEAR FINISH

- A. Interior Solid-Core Door Manufacturer's:
 - 1. Grade: Custom
 - 2. Veneer: VG Doug Fir
 - 3. Veneer Matching: Slip Match
 - 4. Exposed Vertical Edges: Closed-grain hardwood.
 - 5. Core: Particle Board
 - 6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.05 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, 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.

2.06 SITE FINISHING

- A. Finish in shop insofar as possible.
- B. Clear Finish:
 - 1. Grade: Custom
 - 2. Finish: See Section 09 90 00 – Painting and Coating
 - 3. Sheen: Satin

PART 3 - EXECUTION

3.01 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. Any deficiencies must be corrected prior to door installation.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For coordination and installation, see Section 08 71 00 – Hardware.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bev-els as indicated below; do not trim stiles and rails in excess of limits set by man-ufacturer 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 1/2-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.
 2. Bevel non-fire-rated doors 1/8-inch in 2-inches at lock and hinge edges.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.03 ADJUSTING

- A. Operation: Correct any deficiency that prohibits doors from swinging or operat-ing freely. Do not remove hinge screws after initial insertion. Shims used for alignment purposes must be inserted between hinge and frame. Do not insert shims between hinge and door.
- B. To prevent stile failure, ensure that door closers are properly adjusted and do not limit the door opening swing. Limit door opening swing only with a properly located stop.

3.04 CLEANING

- A. Haul and dispose of all waste materials legally.

3.05 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Fab-ricator and Installer, which ensures architectural millwork being without damage or deterioration at time of Substantial Completion.

- 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

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Aluminum windows.
- B. Operating hardware.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 – Weather Barriers
- B. Section 07 62 00 – Sheet Metal Flashing and Trim
- C. Section 07 90 05 – Joint Sealers
- D. Section 08 80 00 – Glazing

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007 (Reapproved 2016).
- E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For manufacturer and installer.
- C. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.

- D. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving weather barrier seal to adjacent construction, anchorage locations, and installation requirements.
- E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
 - 1. Evidence of AAMA Certification.
 - 2. Evidence of WDMA Certification.
 - 3. Evidence of CSA Certification.
 - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- F. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.
- G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.08 WARRANTY

- A. Correct defective Work within a five-year period after Date of Substantial Completion.
- B. Provide ten-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five-year manufacturer warranty against excessive degradation of

exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Thermally broken in-swing aluminum casement window, **SF-1**.

2.02 MANUFACTURERS

- A. Basis of Design: EFCO Series 2700.
- B. Acceptable manufacturers:
 - 1. Kawneer North America.
 - 2. Wausau Window and Wall Systems.
 - 3. Or Approved Equal.
- C. Substitutions: See Section 01 60 00 – Product Substitution Procedures.

2.03 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5005 alloy, H12 or H14 temper.
- C. Concealed Steel Items: Profiled to suit mullion sections; galvanized in accordance with ASTM A123/A123M.

2.04 WINDOWS

- A. **SF-1**, Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
 - 1. Frame Components: 6063-T6 aluminum alloy.
 - 2. Standard frame width: 2 inches.
 - 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
 - 4. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 - 5. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 - 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Performance Requirements: Provide products that comply with the following:
 - 1. Member Deflection: Limit member deflection to flexure limit of glass in any

- direction, with full recovery of glazing materials.
- 2. Air infiltration: less than .10 CFM/SF @ 6.24 PSF
- 3. Water: No Leakage @ 12.0 PSF
- C. In-swinging Casement Type:
 - 1. Construction: Thermally broken profile.
 - 2. Glazing: Single; clear; transparent, in accordance with Section 08 80 00 – Glazing.
 - 3. Exterior Finish: Class I Dark Bronze.
 - 4. Interior Finish: Class I Dark Bronze.
 - 5. Provide with window manufacturer's sill, jamb and head receptors.
 - 6. Provide with window manufacturer's 3-1/2- inches deep aluminum sill with 3/4-inch downward sill extension.

2.02 COMPONENTS

- A. Frames: 2-inch wide by 2-inch deep profile, of 2-inch thick section; flush glass stops of snap-on type.
- B. Glazing: As specified in Section 08 80 00 – Glazing.
 - 1. For Exterior Windows: Type Tempered as indicated. See Window Schedule on the Drawings for additional information.
- C. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to achieve effective weather seal.
- D. Glazing adapter for louver insert as indicated on the Drawings.
 - a. Acceptable manufacturers are Greenheck, Safe-Air Dowco, Or Approved Equal.

2.03 HARDWARE

- A. Sash lock: Lever handle with cam lock.
- B. Operator: Lever action handle fitted to projecting sash arms with limit stops.
- C. Finish: Dark Bronze.

2.04 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41, 2-step electrolytic, Class 1 coating, not less than 0.7 mils thick or greater.
- B. Finish Color: Dark Bronze as selected from manufacturer's standard range of colors.
- C. Glass: As indicated in Section 08 80 00 – Glazing.
- D. Apply 1 coat of bituminous coating to concealed aluminum and steel surfaces in contact with dissimilar materials.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame, head sill, jamb receivers and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Install sill and sill end angles.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- G. Install operating hardware not pre-installed by manufacturer.
- H. Install glass in accordance with requirements specified in Section 08 80 00 – Glazing.

3.02 ADJUSTING

- A. Adjust hardware for smooth operation and secure weathertight closure.

3.03 CLEANING

- A. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.
- D. Dispose of all waste materials legally.

END OF SECTION

SECTION 08 71 00

HARDWARE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Locks and latches.
- B. Cypher Locks.
- C. Hinges.
- D. Mortise locksets.
- E. Surface Door Closers.
- F. Kickplates.
- G. Door Silencers
- H. Gasketing and thresholds.
- I. Finishes.
- J. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 – Hollow Metal Doors and Frames
- B. Section 08 14 16 – Flush Wood Doors

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 00 – Project Coordination.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Coordinate Owner's keying requirements with hardware manufacturers.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.

- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- D. Keying Schedule: Submit for approval of Owner.
- E. Prior to preparation of hardware schedule:
 - 1. Submit one (1) sample of hinge, latchset, lockset, and closer illustrating style, color, and finish.
 - 2. Samples will be returned to supplier.
- F. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Data: For users operation and maintenance of system including:
 - 1. Manufacturer's parts lists and templates.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Bitting List: List of combinations as furnished.
- I. Closeout Submittals: Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.
- J. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

1.05 MAINTENANCE MATERIAL

- A. Extra Lock Cylinders: Ten for each master keyed group.
- B. Tools: One set of all special wrenches or tools applicable to each different or special hardware component, whether supplied by the hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5-years' experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5-years' experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed

products to meet the Performance and Design Criteria.

- B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Mechanical hardware for swinging doors, sliding doors and gates.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Means of Egress Doors: Latches do not require more than 15-lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ANSI 117.1 2017 for Accessible and Usable Building and Facilities.
- C. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- D. Provide items of a single type of the same model by the same manufacturer.

2.03 MANUFACTURERS

- A. Specification is based on product types listed in hardware groups in the contract drawings, from the specific manufacturers listed below.

2.04 LOCKS AND LATCHES

- A. Specification is based on product types listed in hardware groups in the contract drawings, from the manufacturers listed below.
- B. Approved Manufacturers: Best, Schlage (w/ Best compatible IC cores)
- C. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
 - 1. Hardware Sets in the contract documents indicate locking functions required for each door.
 - 2. If no hardware set is indicated for a swinging door provide an office lockset.
 - 3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
 - 4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
 - 5. In door sections, where a lock cylinder referenced to this Section is specified, furnish and install a mortise lock cylinder keyed to the building keying system.
- D. Lock Cylinders: Manufacturer's standard tumbler type, figure 8 locksets with 7-

pin Best interchangeable core cylinders.

1. Provide cams and/or tailpieces as required for locking devices required.
2. In addition to where indicated in hardware schedule in the project drawings provide an additional cylinder for access door.

2.05 CIPHER MECHANICAL LOCKS

- A. Approved manufacturer's:
 1. Schlage, Kaba, Or Approved Equal.
- B. Unless otherwise specified, exposed parts of locks and latches shall be of the metal and finish specified above and shall have the following features:
 1. Mechanical push button lock with manually programmable single access code with small format interchangeable cores.
 2. Meets ANSI A156.25 Grade 1 certified and UL 294 Listed.

2.06 HINGES

- C. Specification is based on product types listed in hardware groups in the contract drawings, from the manufacturers listed below.
- D. Approved Manufacturers: Stanley, Lawrence, McKinney
- E. Hinges: Provide hinges on every swinging door.
 3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 4. Provide ball-bearing hinges at all doors having closers.
 5. Provide hinges in the quantities indicated.
 6. Provide non-removable pins on exterior outswinging doors.
 7. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
- F. Butt Hinges: Comply with BHMA A156.1 and A156.7; standard weight, unless otherwise indicated.
 1. Provide hinge width required to clear surrounding trim.
- G. Quantity of Hinges Per Door:
 1. Doors up to 60-inches High: Two hinges.
 2. Doors from 60-inches High up to 90-inches High: Three hinges.
 3. Doors 90-inches High up to 120-inches High: Four hinges.
 4. Doors over 120-inches High: One additional hinge per each additional 30-inches in height.

2.07 MORTISE LOCKSETS

- A. Specification is based on product types listed in hardware groups in the contract drawings, from the manufacturers listed below.
- B. Approved Manufacturers: Best, Schlage (w/ Best compatible IC cores)
- C. Mortise Locks: BHMA A156.13; stamped steel case with steel or brass parts;

Series 1000.

- D. Locking Functions: As defined in BHMA A156.13, and as follows:
1. Passage: F01.
 2. Privacy: F19, or F02 with retraction of deadbolt by use of inside lever/knob.
 3. Office: F04, key not required to lock, remains locked upon exit.
 4. Classroom: F05, key required to lock.
 5. Communicating: F03, deadbolts operated independently from each side, not an exit.
 6. Entry, Deadbolt: F20, may be locked without key, free egress.
 7. Always-Locked: F07, may not be left unlocked.
 8. Two-Key Entry: F09, outside locked by key from both sides, free egress.
 9. Store Door: F14, deadbolt locked by key from both sides, not an emergency exit (must be unlocked during occupied hours).
 10. Exit Only: F07 or F31, may have outside trim, may not be left unlocked.

2.08 SURFACE DOOR CLOSERS

- A. Acceptable manufacturer's are:
1. LCN, Corbin, Russwin, Or Approved Equal.
- B. Surface-type door closers shall be of a well-proven mechanical design, liquid-controlled type, as indicated in the following hardware sets and of the proper size and shall include the following features:
2. Cast iron or pressure-cast aluminum shell and other cast parts
 3. Wrought parts of malleable iron or steel
 4. Coil spring with power adjustment
 5. Steel, brass, or bronze screws or bolts
 6. Regular, parallel arms as specified
 7. Adjustable back-check
 8. Positive door closing and quiet operation
 9. Five-year factory guarantee of satisfactory performance
- C. Closers shall in no case limit the swing of the door and shall permit the door to open as far as construction conditions permit or to the degree specified.
- D. Closers shall be provided with key-type regulating screws.

2.09 KICKPLATES

- A. Unless specified otherwise, kickplates for exterior doors shall be of 16 gage stainless steel, beveled on four edges; kickplates for interior doors shall be 0.125-inch thick Panelyte by Hager Companies, Ives, Rockwood, Or Approved Equal, color selected by the Architect.
- B. Generally, kickplates shall be ten inches high, with a length equal to the width of the door leaf, less clearance for stops unless otherwise noted or specified on the drawings.

- C. Install kickplates with oval-head, full-thread screws to match kick plate material surface spaced uniformly at a maximum of eight inches.

2.10 DOOR SILENCERS

- A. Provide rubber door silencers for all door frames at openings having single-acting doors in wood or pressed steel frames.
- B. Provide three silencers for single doors. Locate and install in accordance with manufacturer's printed instructions.

2.11 GASKETING AND THRESHOLDS

- A. Gaskets: Complying with BHMA A156.22.
 - 1. Specification is based on product types listed in hardware groups in the contract drawings, from the manufacturers listed below.
 - 2. Approved Manufacturers: Pemko, Reese, National Guard
 - 3. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
 - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
 - 4. On each exterior door, provide door bottom sweep, unless otherwise indicated.
- B. Thresholds: Complying with BHMA A156.21.
 - 1. Specification is based on products types listed in hardware groups in the contract drawings, from the manufacturers listed below.
 - 2. Approved Manufacturers: Pemko, Reese, National Guard
 - 3. At each exterior door, provide a thermally broken threshold unless otherwise indicated.
 - 4. Thresholds need to comply with subsection 2.02 these specifications.
 - 5. Field cut threshold to frame for tight fit. Set in continuous sealant.

2.12 FINISHES

- A. Provide finishes complying with BHMA A156.18, US10B unless otherwise noted except:
 - 1. Door Closers – painted to match door hardware.

2.13 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting

work.

- B. Verify that doors and frames are ready to receive work; labeled, fire rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Use templates provided by hardware item manufacturer.
- C. Do not install surface mounted items until finishes applied to substrate are complete.
- D. Install hardware on fire rated doors and frames in accordance with code and NFPA 80.
- E. Mounting heights for hardware from finished floor to center line of hardware item.
 - 1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."
 - 2. For Wood Doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- F. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.04 FIELD QUALITY CONTROL

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.05 ADJUSTING

- A. Adjust and lubricate hardware for proper operation.

3.06 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality.
- B. Dispose of all waste legally.

3.07 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.08 SCHEDULE

- A. Hardware schedule as indicated on the Drawings.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Delegated design of glazing units.
- B. Glazing Units.

1.02 RELATED REQUIREMENTS

- A. Section 08 51 13 – Aluminum Windows

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For Installer, fabricator and design engineer.
- C. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Product Data:
 - 1. Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
 - 2. Glazing Compounds & Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements and identify available colors.
- E. Shop Drawings: For any glazing installed with components from this section alone.
- F. Submit shop drawings for glazing installed within other systems in accordance with the system submittal requirements.
- G. Sample: Submit two samples in manufacturer's standard size of glass type units, showing coloration and design. No less than 12-inches by 12-inches each.
- H. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

- J. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.04 QUALITY ASSURANCE

- A. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5-years of experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5-years' experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.06 WARRANTY

- A. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- B. Tempered Glass: Provide a ten (10) year warranty including replacement of failed units.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Glass glazing and accessories installed as monolithic glazing, glazing units, or horizontal glazing within framing systems and support structures specified elsewhere.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- B. Roll Wave Maximum Distortion Tolerance: 0.003-inch target with 0.005-inch maximum peak to valley measurement.
- C. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C 1048.
- D. Thickness: As required for loads indicated.
- E. Deflection no greater than 1/175 of the longest dimension or 1/2-inch whichever is less.

2.03 MATERIALS

- A. Acceptable manufacturers:
 - 1. Cardinal Glass Industries.
 - 2. Vitro Architectural Glass.
 - 3. Old Castle Building Envelope.
 - 4. Guardian Industries.
 - 5. Or Approved Equal.
- B. Float Glass:
 - 1. Performance Criteria:
 - a. By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 - b. Roll Wave Maximum Distortion Tolerance: 0.003 inch target with 0.005 inch maximum peak to valley measurement.
 - c. Bow and Warp Maximum Tolerance: 50 percent of the maximum allowed in ASTM C 1048.
 - d. Tinted Types: Performance and features to match basis of design product.
 - 2. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 - 3. Heat-Strengthened in accordance with ASTM C1048.
 - 4. Fully Tempered in accordance with ASTM C1048.
 - a. Safety Glazing: Comply with 16 CFR 1201 test requirements for Category II.
- C. Tempered Glass:
 - 1. Performance Criteria:
 - a. Clear float glass; Condition A (uncoated), Type I (transparent, flat), Class 1 (clear), Quality q3 (glazing select); fully tempered (FT).
 - b. Safety Glazing Labeling: Permanently mark glazing with certification label of the SGCC or acceptable certification agency to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturers name, type of glass, thickness and safety glazing standard with which the glass complies.
- D. Sealed Insulated Glass Units:
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Edge Spacers: Warm Edge Construction: Triple seal design of extruded, thermoset polymer structural silicon spacer with integrally incorporated desiccants conforming to ASTM E2188; and secondary seal of polyurethane, polysulfide or hot-melt butyl elastomeric sealant (fabricator's option). Size to be .5 inches in manufacturer's standard color black.
 - a. Color: Black.
 - 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - a. Color: Black.
 - 4. Air Space: Argon.
 - 5. U-Value: As required to meet performance criteria of complete

assembly, not to exceed 0.24 Center of Glass.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.05 SCHEDULE

- A. Aluminum Windows:
 - 1. Applications: Exterior vision glazing at in locations indicated on the Drawings.
 - 2. Performance:
 - a. U-Value: As required to meet performance criteria of complete assembly indicated in related specification sections.
 - 3. Outboard Lite: Clear Float.
 - a. Coating: Vitro Solarban 70XL Low-E Coating on #2 surface
 - 4. Air Space: Argon as required to meet full system U-values.
 - 5. Inboard Lite: Clear Float; tempered as required by local code and design of insulating glazing units.
 - 6. Lite Thickness: As required by panel size indicated when designed in accordance with performance criteria.
 - 7. Total Insulating Glazing Unit Thickness: 1-inch.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Gypsum board systems on interior walls and ceilings.
 - 2. Moisture and mold resistant gypsum wallboard to be installed in restrooms and break room.
 - 3. Accessories and auxiliary materials as indicated and as required.
 - 4. Trim accessories, joint compound, control joints, fasteners, and sealants.

1.02 RELATED SECTIONS:

- A. Section 06 10 00 – Rough Carpentry
- B. Section 06 20 00 – Finish Carpentry
- C. Section 09 65 13 – Resilient Base and Accessories
- D. Section 09 90 00 – Painting and Coating

1.03 STANDARD SPECIFICATIONS:

- A. Conform to Recommended Specifications for the Application and Finishing of Gypsum Board as published by the Gypsum Association.

1.04 SUBMITTALS:

- A. Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's published literature for specified products and accessories as applicable, including manufacturer's specifications, physical characteristics, and performance data. Submit as a supplement, manufacturer's instructions and directions for application if not included in manufacturer's published literature.

1.05 STORAGE AND HANDLING:

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. National Gypsum Co., U.S. Gypsum Co., Kaiser Gypsum Co., Bestwall Gypsum Co., Pabco Products Co., or approved.

2.02 GYPSUM WALLBOARD:

- A. Wallboard:
 - 1. Edges: Tapered.
 - 2. Joints: Butt.
 - 3. Thicknesses 5/8-inch unless otherwise indicated.
 - 4. Fire rated Type C @ 5/8-inch where indicated.
 - 5. Moisture resistant: Use in toilet rooms, shower rooms, bathrooms, wet areas, and any wall within 8-feet of plumbing fixtures or plumbed appliances.
 - 6. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
- B. Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

2.03 MOISTURE RESISTANT GYPSUM WALL BOARD:

- A. ASTM C630, standard type, Type X fire-rated, water-resistant gypsum board shall be used as indicated on the Drawings in areas of high humidity.
- B. Products:
 - 1. Georgia-Pacific Gypsum, James Hardie Gypsum, U.S. Gypsum.

2.04 SCREWS:

- A. ASTM C646 Type W for use on wood framing. 1-inch for single layer or for base layer, 1-1/4-inch W #6 screws for single layer or for base layer per GA File No. WP 3514. For trim and other fastenings, as recommended by the manufacturer.

2.05 METAL TRIM:

- A. Drywall Accessories: comply with ASTM C1047, provide the following items fabricated completely of heavy gage galvanized sheet steel and distributed by the gypsum board manufacturer. Shapes and sizes shown in Standard Specifications, formed from zinc-coated steel conforming to Federal Specification QQS-775, class d or e, not less than 25-gauge.
 - 1. Corner Bead: Gypsum Association Type CB 114 x 114 having 1-1/4-inch or wider flanges.
 - 2. Casing: Gypsum Association Type LC-58 or sized as necessary to receive board and designed for finishing with Joint Treatment.
- B. Casing with vinyl gasket having 1/4-inch vinyl foam tape.
- C. Control Joint: "V" shaped with 7/8-inch flanges.

- D. Special Shapes: J-mold as noted in the drawings.
 - 1. Concealed Trim:
 - a. Paper Faced Metal Bead and Trim: ASTM C1047, electro-galvanized steel with paper face and flanges, USG Beadex specified for type and quality.
 - b. Outside corner beads
 - c. Inside corners
 - d. L-type edge trim

2.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30-feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30-feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

2.07 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings typical throughout.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- D. Feather coats of joint compound so that camber is maximum 1/32-inch.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Comply with applicable requirements of Standard Specifications, except as herein modified. Assure that 50-degree F. temperature will be maintained. Provide solid blocking behind all vertical joints not on framing members.
- B. Placement of Wallboard: Use minimum replacement board size of 2-foot by 2-foot. Place boards in moderate contact; do not force into place. Stagger vertical

and transverse joints; arrange joints on opposite sides of a partition so as to occur on different studs.

- C. Leave a 5/8-inch gap between all wallboard and floor surface.
- D. Attachment: Use specified screws at 12-inch on center in field of board and 8-inch on center staggered along vertical edges.
- E. Ensure that insulation is properly placed in partitions.
- F. Metal Trim: Use metal casings at all joints between wallboard and other materials. Use specified metal trim on all external corners.
- G. Sanding: When sanding use wet sanding procedures or seal off work area from rest of the building.

3.02 FINISH:

- A. All exposed walls and ceilings to receive smooth finish, suitable for paint or wall covering, or match existing at direction of Architect.

3.03 JOINT TREATMENT:

- A. All work shall conform to the applicable requirements of Standard Specifications and to the recommendations of the wallboard manufacturer. All exposed work shall be smooth and free from defects. Tape and cement all joints; reinforce all corners; fill all exposed fastener heads. Fill all cracks at electrical outlets and similar for fireproofing. Repeat process as many times as necessary for appearance. All exposed joints and fastener heads shall be smooth and flush with surface of board. Fire tape at attic spaces.

3.04 REPAIR:

- A. After installation of drywall assemblies and before application of finish painting or other scheduled finish, inspect work for any deficiencies and correct same; leave drywall assemblies complete with trim as indicated, ready for finish plastering or other finish treatment as scheduled.

3.05 CLEANING:

- A. Haul and dispose of all waste materials legally.
- B. Remove excess debris from floor, base, and wall surfaces without damage.
- C. Initial cleaning and finishing is the responsibility of the contractor.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Wall tile.
- B. Installation materials.
- C. Installation methods.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 – Joint Sealers
- B. Section 09 21 16 – Gypsum Board Assemblies
- C. Section 10 28 00 – Toilet Accessories
- D. Division 22 – Plumbing

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For installer.
- C. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- D. Shop Drawings: Indicate membrane and tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details and related dimensioning as well as plumbing (drains) mechanical and electrical fixtures and lines installed.
- E. Sample: Mount tile and apply grout on two plywood panels, minimum 24-inch x 36-inch in size illustrating pattern, color variations, and grout joint size variations.
- F. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 MAINTENANCE MATERIAL

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- B. As required by Section 01 78 23 – Operations and Maintenance Data.
 - 1. Extra Tile: 12 square feet of each size, color, and surface finish combination.
 - 2. Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
 - 3. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance, or to adjacent fixtures, fittings, or finishes.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum of 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.07 WARRANTY

- A. Installation Warranty: Contractor shall correct defective Work within a two year period after Date of Substantial Completion;
- B. Manufacturer Warranty: Provide five year warranty for tile setting materials failing to resist penetration of water.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Tile assemblies and accessories installed in accordance with Tile Council of North America guidelines on walls.
- B. Section also includes non-ceramic trim. Mortar materials: Latex-Portland Cement type: ANSI A118.4. Grout: Polymer modified ANSI A118.7, Epoxy ANSI A118.3.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Blending: For tiles with color variations, factory blend and package tile so each package has the same range of colors and quantities of each variation. If factory blending is not available, field blend prior to beginning installation.

2.03 TILE

- A. Specification is based on products listed below.

1. Substitutions for products by manufacturers other than those listed below:
See Section 01 60 00 – Product Substitution Procedures.

B. Wall Tile

1. Ceramic wall tile shall be not less than 5/16-inch thick; shall have a colored, matte, glazed finish; and sizes shall be as indicated, with spacer lugs or similar feature at the edges of the units.
 - a. T1: Pure, White, Gloss.
 - 1) Manufactured by Sonoma.
 - 2) Distributed by United Tile.
 - 3) Size: 3-inch by 6-inch.
 - b. Or Approved Equal.

2.04 INSTALLATION MATERIALS

A. Bond Coat:

1. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
 - a. Specification is based on:
 - 1) EBM-Lite Epoxy Bonding Mortar by Custom Building Products.
 - 2) WA Epoxy Adhesives by ARDEX Engineered Cements.
 - 3) Kerapoxy 410 by Mapei.
 - 4) Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.
 - b. Performance:
 - 1) Water Cleanable Setting Epoxy.
 - 2) Non-Sag Characteristics for Wall Tile Installations.

B. Grout:

1. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - a. Specification is based on:
 - 1) SpectraLOCK PRO Premium Epoxy Grout by Laticrete.
 - 2) Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.
 - b. Performance:
 - 1) For Use in Grout Joints 1/16-inch to 1/2-inch in width.
 - 2) Resistant to Oleic Acids and No-Rinse Cleaning Agents Normally Associated with Commercial Kitchen Conditions.
 - 3) Rated for use in both floor and wall applications, maintaining non-sag characteristics for vertical grout joints.
 - 4) Water Cleanable 100 percent Solids Grouting Epoxy.
 - c. Features:
 - 1) Color: AccuColor 908 Dove Gray.

C. Waterproof Membrane:

1. Specifically designed for bonding to cementitious substrate and thinset tile over a sloped mortar bed; complying with ANSI A118.10.and ANSI A108.13.

- a. Specification is based on:
 - 1) RedGuard Waterproofing & Crack Prevention Membrane by Custom Building Products.
 - 2) 8+9 rapid waterproofing by ARDEX Engineered Cements.
 - 3) Mapelastic 400 by Mapei.
 - 4) Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.
 - b. Performance:
 - 1) Thickness: 25 mils, minimum, dry film thickness.
 - 2) Thin-Load Bearing Membrane Designed to Suppress Horizontal In-Plane Cracks in Concrete Up to 1/8-inch in width.
- D. Joint Sealant:
- 1. For treatment of movement, expansion, and change of plane joints in tile work, complying with ASTM C920, and requirements of TCNA section EJ-171.
 - a. Specification is based on:
 - 1) 100 percent Silicone Commercial Sealant by Custom Building Products.
 - 2) SX 100 percent silicone sealant by ARDEX Engineered Cements.
 - 3) Mapesil by Mapei.
 - 4) Substitutions for products by manufacturers other than those listed above: See Section 01 60 00-Product Substitution Procedures.
 - b. Performance:
 - 1) Sealant Material Must Maintain Shore A Hardness of 20 or Greater for conditions exposed to foot traffic.
 - 2) Sealant Material Must be Color Matched to Selected Grout Color.
- E. Tile Backer Board:
- 1. Glass mat backerboard complying with ASTM C1178/C1178M, Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel, of inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - a. Manufacturers:
 - 1) DensShield Tile Backer by Georgia-Pacific Gypsum.
 - 2) Durock Brand Backerboard by USG Corporation.
 - 3) HardieBacker Cement Board by James Hardie Building products Inc.
 - 4) Substitutions for products by manufacturers other than those listed above, see Section 01 60 00 – Product Substitution Procedures.
 - b. Performance:
 - 1) Core: Type X.
 - 2) Thickness: 1/2-inch.
 - 3) Mold Resistance: ASTM D3273.

- 4) Fasteners: 1-5/8-inch hot dipped galvanized course thread screw and construction adhesive for SIPS substrate 8-inches on center. For wood framing, use 1-5/8-inch hot dipped galvanized wood screws 8-inches on center.

2.05 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present. Lay out the Work so that no tile less than half-size occurs. Where heights are dimensioned on the drawings, maintain full courses to produce a height nearest to this dimension without cutting tile.
- B. Extend tile work into recesses and under or behind fixtures and cabinets to form a complete covering without interruptions. Terminate work neatly at obstructions, edges, and corners.
- C. Ground Tile: When partial tiles must be used on exposed edges:
 1. Grind the edges of cut unglazed thru-body tile to mimic the factory edge and place the cut edge in.
 2. If a cut edge must face out; grind with fine enough grit to match the finish texture of the tile as close as possible.
 3. Submit samples for approval prior to commencing work.
- D. Lay tile to pattern indicated. See Drawings.
 1. Do not interrupt tile pattern through openings.
 2. Align wall, and trim joints where sizes permit.
 3. Lay out tilework and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting and small pieces.
- E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
 1. Wall Tile: 1/16-inch.
- F. Maximum allowable lippage beyond actual measured warpage is 1/32 inch.

- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints.
- K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 CLEANING

- A. Clean and disinfect the area of ceramic tile Work ready for use.
- B. Haul and dispose of all waste materials legally.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.
- B. Apply heavy kraft paper as a minimum to prevent surface damage during construction and remove before final inspection.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Resilient base.
- B. Resilient installation accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 20 – Project Meetings.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For Installer.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- D. Shop Drawings: Indicate seaming plan.
- E. Base and Accessory Samples: Submit manufacturer's complete set of color samples for initial selection.
- F. Certificate: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

3. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.04 MAINTENANCE MATERIAL

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. As required by Section 01 78 23 – Operations and Maintenance Data.
 2. Extra Wall Base: 10-linear feet of each type and color (4-foot sections are not acceptable except as maintenance stock.)

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of work specified in this section with minimum 5-years of experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3-years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

1.07 WARRANTY

- A. Provide minimum Manufacturers Limited 5-year commercial warranty for manufacturing defects.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Resilient base and installation accessories for transition to other flooring types.
- B. Resilient Base: ASTM F 1861, Type TS rubber, vulcanized thermoset, top set Style.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.

2.03 RESILIENT BASE

- A. Resilient Base (RB-1): ASTM F1861, top set Style B cove, and as follows:
 1. Basis of Design: product, color, height and profile: Roppe, 194, Burnt Rubber.
 2. Height: 6-inch.
 3. Thickness: 0.125-inch thick.

4. Finish: Satin.
5. Length: Roll.
6. Comparable products by one of the following are also acceptable.
 - a. Burke Flooring: www.burkemercer.com.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Roppe Corp: www.roppe.com.
 - d. Or Approved Equal.
7. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.

2.04 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Primers, Adhesives, and Seaming Materials:
 1. Waterproof; types recommended by flooring manufacturer.
- C. Filler for Coved Base:
 1. Plastic.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified, are dust- free, and are ready to receive resilient base.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General:
 1. Install all materials in accordance with manufacturer's instructions based on conditions present.
 2. Starting installation constitutes acceptance of sub-floor conditions.
 3. Fit joints tightly.
- B. Resilient Base:
 1. Fit joints tightly and make vertical. Maintain minimum dimension of 18- inches between joints.
 2. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold and securely wrap with a minimum distance of 12-inches.
 3. Install base on solid backing. Bond tightly to wall and floor surfaces.
 4. Scribe and fit to door frames and other interruptions.

3.04 CLEANING

- A. Dispose of all waste material legally.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Initial cleaning and finishing is the responsibility of the contractor.
 - 1. Follow manufacturer's recommendations for initial cleaning and finishing procedures.
 - 2. Not all types of flooring require finishing.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

SECTION 09 81 00

ACOUSTICAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY OF WORK

- A. The extent and location of "Acoustical Insulation" Work as indicated in the Contract.

1.02 GOVERNING CODES, STANDARDS, AND REFERENCES

- A. ASTM C665 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building partitions and Elements.
- C. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.04 PRODUCT HANDLING

- A. Protection from Deterioration: Do not allow insulation materials to become wet or soiled, or covered with ice or snow. Comply with the manufacturer's recommendations for handling, storage and protection during installation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sound Attenuation Blankets: Semirigid, friction-fit, spun mineral-fiber blanket without membrane covering; flame-spread, smoke, and fuel ratings of less than 25, UL-723; ASTM C655, Type I; type recommended by manufacturer for maximum sound attenuation; thickness to fill stud cavity.
- B. Location: See Wall Schedule on the Drawings for location.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with the manufacturer's instructions for the particular conditions of installation.
- B. Extend insulation at full thickness, as shown, over the entire surface to be insulated; cut and fit tightly around obstructions and fill voids with insulation and mastic.
- C. Apply a single layer of insulation of the required thickness unless otherwise shown or required to make up the total thickness.

3.02 CLEANING

- A. Haul and dispose of all waste materials legally.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Interior paint systems.
- B. Interior semi-transparent stain with clear coat systems.
- C. Exterior clear spar urethane systems.
- D. Exterior steel paint and coating systems.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 – Metal Fabrications
- B. Section 06 20 00 – Interior Finish Carpentry
- C. Section 07 46 23 – Wood Siding
- D. Section 08 11 13 – Hollow Metal Doors and Frames
- E. Section 08 14 16 – Flush Wood Doors
- F. Section 09 21 16 – Gypsum Board Assemblies

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section 01 31 20 – Project Meetings.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.
- C. Paint Sample: Submit three paper draw down samples, 8.5-inch by 11-inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- D. Stain Clear Coat Sample: Submit three 12-inch long samples of ceiling and base

material in size illustrating range of colors and textures available for each surface finishing product scheduled.

- E. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- F. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 3. Recommendations on maintenance schedule.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in the manufacture of paint and coating products used in the work of this section with minimum ten years of experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience on projects of similar size and complexity.

1.06 MOCK-UP

- A. Paint one wall (from corner to corner) of selected rooms to serve as a mock-up.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the Work if accepted.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- B. Provide all paint and coating products used in any individual system from the same manufacturer, unless noted otherwise below.
- C. Paints:
 - 1. Pkr: Comex Group (Color Wheel, Frazee, General Paint, Kwal, or Parker): www.thecomexgroup.com
 - 2. K-M: Kelly Moore Paints. www.kellymoore.com
 - 3. B-M: Benjamin Moore & Co: www.benjaminmoore.com
 - 4. Rodda: Rodda (Cloverdale, Zinsser, XIM) www.rodgapaint.com
 - 5. S-W: Sherwin-Williams Co. www.sherwin-williams.com
- D. Clear Spar Urethane Sealers:

1. Cabot: Cabot Spar Varnish: www.cabotstain.com
 2. V-T: Varathane, Rust-Oleum, www.rustoleum/varathane.com
 3. S-W: Sherwin-Williams Co., Minwax Helmsman, www.sherwin-williams.com
- E. Interior Semi-Transparent Stain:
1. G-F: General Finishes: : www.generalfinishes.com
 2. V-T: Varathane, Rust-Oleum, www.rustoleum.com
 3. S-W: Sherwin-Williams Co., Minwax Performance Series, www.sherwin-williams.com
 4. Or Approved Equal.
- F. Clear Conversion Varnish Sealers:
1. Sherwin Williams
 - a. Sealer: Gemini 275 Conversion Varnish White Sanding Sealer.
 - b. Top Coat: Sher-Wood Kemvar (V84F90041) Clear Varnish.
 2. Benjamin Moore & Company:
 - a. Sealer: BENWOOD Quick Dry Sanding Sealer 413.
 - b. Top Coat: LENMAR Megavar Plus High Solids Water White Conversion Varnish.
 3. Or Approved Equal.
- G. Exterior Metal Doors and Frames.
1. Benjamin Moore & Company
 - a. Primer: Ultra Spec HP Acrylic Primer, HP04.
 - b. Intermediate coat: Ultra Spec HP D.T.M. Acrylic Low Luster, HP25.
 - c. Top coat: Ultra Spec HP D.T.M. Acrylic Low Luster, HP25.
 2. Sherwin Williams
 - a. Primer: Multi Purpose Latex Primer/Sealer.
 - b. Intermediate coat: ProIndustrial Acrylic Coating.
 - c. Exterior coat: ProIndustrial Acrylic Coating.
 3. Or Approve Equal.
- H. Exterior Architectural Ferrous Metal.
1. Tnemec
 - d. Primer: Tnemec Series 94H20.
 - e. Intermediate coat: Tnemec Series 66HS.
 - f. Exterior coat: Tnemec Series 1071 Fluoronar.
 2. PPG Industries
 - g. Primer: PPG – Durethane MCZ.
 - h. Intermediate coat: PPG – Americoat 385.
 - i. Exterior coat: PPG – Coraflon ADS.
 4. Or Approve Equal.
- I. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.

2.02 DESCRIPTION

- A. Surface preparation and field application of paints, stains, spar urethane, and other coatings.
- B. High commercial quality coating systems for gypsum, wood, ferrous and non-ferrous metal by Sherwin-Williams, Benjamin Moore & Co. or comparable manufactures.
 - 1. Paint finish for GWB: (3 coat system) primer + minimum 2 color coats. Gloss level at walls = satin (MPI G4). Gloss level at ceilings = satin (MPI G4).
 - 2. Paint finish on doors and frames = semigloss (MPI gloss level G5).
 - 3. See Drawings and Schedules for paint location and color.
- C. Clear Spar Urethane Sealer: Low VOC two-coat high performance oil based exterior spar urethane sealer system for exterior wood soffit with clear satin finish, UV-protection with mold and mildew resistance.
- D. Semi-Transparent Stain: Low VOC two-coat high performance water based interior swemi-transparent stain system for interior wood ceilings and doors with clear satin finish.

2.03 MATERIALS

- A. Paint Systems:
 - 1. PS-01 Acrylic-Enamel.
 - a. Substrate: Gypsum Board.
 - b. Benjamin Moore & Company:
 - 1) Primer: 046 Fresh Start 100% Acrylic Superior Primer.
 - 2) Top coat: 526 Aura Waterborne Satin (2 coats min.)
- B. Spar Varnish Systems:
 - 1. PS-02: Spar Varnish
 - a. Substrate: Wood siding and soffit.
 - b. Varathane:
 - 1) First Coat: Varathane Ultimate Spar Varnish 2 mils DFT.
 - 2) Second Coat: Varathane Ultimate Spar Varnish 2 mils DFT.
 - 3) Third Coat: Varathane Ultimate Spar Varnish 2 mils DFT.
 - a) Wood siding only.
- C. Semi-Transparent Stain and Clear Coat Systems:
 - 1. PS-03: Interior Stain with Clear Coat
 - a. Substrate: Interior flush wood doors, wood base.
 - b. Stain with clear coat:
 - 1) First Coat: General Finishes Stain.
 - 2) Second Coat: Sanding Sealer.
 - 3) Third Coat: Clear Varnish.
 - 4) Fourth Coat: Clear Varnish, doors and base trim only.
- D. Paint for Exterior Metal Door & Frame:
 - 2. PS-04 Acrylic-Enamel.
 - a. Substrate: Metal door and Frame.

- b. Paint:
 - 1) Primer: Shop applied primer shall be applied at 2 mils DFT.
 - 2) Second Coat: Shop or field applied acrylic at 1.5 mils DFT.
 - 3) Top Coat: Field applied acrylic at 1.5 mils DFT.
- E. Paint / Coating for Exterior Architectural Ferrous Metal:
 - 1. PS-05: Exterior Ferrous Metal Paint
 - a. Substrate: Fabricated steel window and louver surrounds.
 - 1) First Coat: Base coat shall be a shop applied zinc rich primer.
 - a) Coating shall be applied at 2.5 to 3.5 mils DFT.
 - b) Surface preparation shall be a minimum of SSPC-SP6/NACE3 – Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
 - 2) Second Coat: Shop applied high solids epoxy.
 - a) Coating shall be applied at 3.0 to 5.0 mils DFT.
 - 3) Third Coat: Shop applied advanced thermoset solution fluoropolymer.
 - a) Coating shall be applied at 2 mils DFT.
 - b. Color: RAL 6014, Yellow Olive.

2.02 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Manufacturer's optional accessories required by the project:

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. General: Apply the coatings in accordance with the manufacturer's recommendations as to the application, weather and temperature conditions. Provide "highest" quality workmanship performed to the Architect's satisfaction. Use clean equipment and brushes when applying paint; spread paint materials evenly, without runs, sags, laps, or brush marks, without variations in color, texture, or sheen and without "holidays." Vary colors or sheens between coats and apply all coats to uniform thicknesses. Cut sharp lines against other materials and different colors. Recoat suction spots in the first coat on drywall as necessary to produce uniformity of color and gloss. Refinish any Work judged defective at no additional cost to the Owner; repair all Work damaged during the progress of the construction. Leave finished surfaces clean, completely covered, uniform in appearance.

- B. Exterior Wood: For Exterior Wood Siding and Soffit, bare wood must be clean, dry and free of grease, sawdust, etc.
 - 1. Degrease all surfaces with acetone, allow to dry before applying varnish. Work within one hour's time of wiping down with acetone and applying varnish. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 CLEANING

- A. General: During the progress of the work, remove from the project all discarded paint materials, rubbish, cans and rags. Leave premises clean and in orderly condition.
- B. Cleaning: Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. Dispose of all waste material legally.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.
- B. Use tarpaulins or drop cloths when working above or adjacent to completed Work; clean all paint splatters and stains from finished surfaces. Protect all Work from dust and insects.

3.06 SCHEDULE

- A. Interior Coating Systems:
 - 1. Interior:
 - a. Gypsum Board - Ceilings:
 - 1) System: PS-01 Acrylic-Enamel.
 - 2) Sheen: Satin
 - 3) Color: As indicated on the Drawings and Schedule these specifications.
 - 4) Location: Restroom 103, Utility 104.
 - b. Gypsum Board - Walls:
 - 1) System: PS-01 Acrylic-Enamel.
 - 2) Sheen: Satin
 - 3) Color: As indicated on the Drawings and Schedule these

specifications.

- 4) Location: Entry 101, Breakroom 102, Restroom 103, Utility 104.
 - c. Interior Woodwork: Flush Wood Doors:
 - 1) System: PS-03 Stain with Clear Finish.
 - 2) Sheen: Satin
 - 3) Color: Clear
 - 4) Location: Entry 101, Breakroom 102, Restroom 103, Utility 104.
 - d. Interior Woodwork: Wood Base:
 - 1) System: PS-03 Stain with Clear Finish.
 - 2) Sheen: Satin
 - 3) Color: Clear
 - 4) Location: Entry 101, Breakroom 102.
- B. Exterior Coating Systems:
- 1. Exterior:
 - a. Wood TG Siding:
 - 1) System: PS-02 Spar Varnish.
 - 2) Sheen: Satin
 - 3) Color: Clear
 - 4) Location: Building exterior as indicated on the Drawings.
 - b. Wood TG Soffit:
 - 1) System: PS-02 Spar Varnish.
 - 2) Sheen: Satin
 - 3) Color: Clear
 - 4) Location: Building exterior as indicated on the Drawings.
Wood
 - c. Metal Doors and Frames:
 - 1) System: PS-04 paint.
 - 2) Sheen: Satin
 - 3) Color: As noted on the Finish Legend on the Drawings.
 - 4) Location: Building exterior as indicated on the Drawings.
 - d. Exterior Architectural Ferrous Metal, Door/Window/Louver Surround:
 - 1) System: PS-05 paint.
 - 2) Sheen: Satin
 - 3) Color: As noted on the Finish Legend on the Drawings.
 - 4) Location: Building exterior as indicated on the Drawings.
- C. Colors:
- 1. Color Schedule as indicated these specifications and on the Finish Schedule on the Drawings.

END OF SECTION

SECTION 10 11 00
MISCELANEOUS SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract.

1.02 SUMMARY

- A. The extent and location of 'Miscellaneous Specialties' or 'Key Box' Work as shown in the Contract Documents.
- B. Work includes:
 - 1. Key Lock Box.

1.03 Related Requirements:

- 1. 06 10 00 – Rough Carpentry
- 2. 07 26 43 – Wood Siding

1.04 REFERENCES

- A. UL 1037, Standard for Antitheft Alarms and Devices
- B. UL 1610, Standard for Central-Station Burglar Alarm Units
- C. UL 1332, Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment
- D. UL 437, Standard for Key Locks

1.05 SUBMITTALS

- A. Submit material data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products.
- B. Submittals shall include the following:
 - 1. Shop Drawings: Submit for each type of Keyed Lock Box include sections of typical trim members and dimensioned elevations. Show anchors, installation details, and blocking and backing requirements.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain keyed lock box from a single source and from a single manufacturer.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Specialties shall be protected so as to prevent damage to them. Damaged items, if any, shall be repaired or replaced to the satisfaction of the Engineer at no additional cost to the Owner.

- B. Deliver factory built high-capacity key lock box to site.

PART 2 PRODUCTS

2.01 KEY LOCK BOX

- A. Klock box with weather resistant door gasket and factory finish.
 - 1. Steel Housing: 1/4-inch steel plate.
 - 2. Door/Hinge: 1/2-inch inch steel door with interior gasket seal and stainless-steel door hinge.
 - 3. UL Listing: Vault and Lock.
 - 4. Cover Coat Finish: Manufacturers proprietary finish.
 - a. Color: Black.
 - 5. Dimensions: 5-inches high by 4-iches wide by 3-inches deep.
 - 6. Mounting Type: Semi-recessed Mount, as indicated on the Drawings.
 - 7. Location: As indicated on the Drawings.

2.02 MANUFACTURERS

- A. Knox Company.
- B. Or Approved Equal.

2.03 GENERAL FINISH REQUIREMENTS

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

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor to coordinate with local Authority Having Jurisdiction for key lock box.
- B. Install building specialties as shown and in accordance with the manufacturer's recommendations and printed instructions. Prior to the installation of the building specialties, consult with the Engineer so that minor adjustments in the locations can be decided to make the installations more attractive in appearance. Install materials plumb or level as applicable and attach securely to the adjacent materials with suitable fasteners. Prevent scratching or damaging adjacent materials during the installation.
- C. Components: Deliver factory-built keyed lock box completely assembled in one piece.
- D. Position: Install units in locations and mounting heights as indicated on Drawings and in accordance with manufacturer's instructions, keeping perimeter lines straight, plumb and level. Provide solid blocking, anchors, trim, and

accessories for complete installation.

- E. Keys: Consult with Owner or Owner's representative.

3.02 PREPARATION

- A. Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication where possible to ensure proper fitting of Work.
- B. Comply with manufacturer's written instructions for surface preparation.

3.03 CLEANING & PROTECTION

- A. After completion, but prior to acceptance, protect item from all damage.
- B. Clean key lock box according to manufacturer's written instructions.
- C. Touch up factory applied finishes to restore damaged or soiled area.
- D. Protect after installation and cleaning.
- E. Haul and dispose of all waste materials legally.

3.04 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to the Owner or the Owner's representative, which ensures miscellaneous specialties being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Delegated design of signage and supports.
- B. Dimensional character signs.
- C. Panel Signs.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section in accordance with Section - Administrative Requirements.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Qualification Data: For fabricator and design engineer.
- C. Delegated-Design Submittal: For assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Product Data: Provide product criteria, characteristics, accessories, jointing and attachment methods.
- E. Shop Drawings:
 - 1. Show sign mounting heights, locations of supplementary supports, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- F. Sample: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Aluminum: For each form, finish, and color, on 6-inch long sections of extrusions and squares of sheet at least 4-inches by 4-inches.
 - 2. Acrylic Sheet: 8-inches by 10-inches for each color required.
 - 3. Panel Signs: Not less than 12-inches square for each type.
 - 4. Accessories: One of each, for each type.

- G. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- H. Maintenance Data: For users operation and maintenance of system including:
 - 1. As required by Section 01 78 23 – Operations and Maintenance Data.
 - 2. Methods for maintaining system's materials and finishes.
 - 3. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.
 - 4. Include manufacturers' brochures and parts lists describing the actual materials installed.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Professional structural engineer with 5-years of documented experience in design of this work and licensed in the location of the project.
- B. Fabricators Qualifications: Company specializing in performing the work of this section with minimum 5-years of experience on projects of similar size and complexity.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Signage as required by code and to facilitate wayfinding.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Tactile and Braille Characters: Text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Produce precisely formed characters with square-cut edges free from burrs and cut marks. Text shall be accompanied by Grade 2 Braille. Braille dots with domed or rounded shape produced using Raster Method.
 - 1. Raised-Copy Thickness: Not less than 0.7 mm and not more than 3 mm.

2.03 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- B. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.04 FINISHES

- A. Painted Finishes: Specification is based on products listed by Matthews Paint.
 - 1. Comparable products by one of the following are also acceptable. See Section 01 33 00 – Product Requirements for Submittal Procedures.
 - a. Akzo Nobel.
 - 2. Substitutions for products by manufacturers other than those listed above: See Section 01 60 00 – Product Substitution Procedures.
 - 3. Aluminum:
 - a. Primer: 274 Series Epoxy Primer, color as required for topcoat color indicated, 1.5 - 2.0 mils DFT.
 - b. Topcoat: VOC MAP, 2.0 mils DFT minimum, satin sheen unless indicated otherwise.
 - 4. Acrylic, Polycarbonate:
 - a. Primer: 74 777SP Tie Bond 0.4 - 0.6 mils DFT.
 - b. Topcoat: VOC MAP, 2.0 mils DFT minimum, satin sheen unless indicated otherwise.

2.02 FABRICATION

- A. Dimensional character signs:
 - 1. Fabricated Channel Characters: Form exposed faces and sides of characters to produce surfaces free from warp and distortion. Include internal bracing for stability and attachment of mounting accessories.
 - 2. Provide manufacturer's hardware for projection mounting of channel characters at distance from wall surface indicated.
 - 3. Signage material, color and finish as Scheduled.
- B. Panel Signs:
 - 1. Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16-inch measured diagonally from corner to corner signs.
 - 2. Edge Condition: Square.
 - 3. Corner Condition: Square.
 - 4. Mounting: Unframed, as indicated.
 - a. Wall or Projection mounted with concealed attachment.
 - b. Manufacturer's standard anchors for substrates encountered.
 - 5. Tactile Characters: Characters and Grade 2 Braille raised 1/32-inch (0.8 mm) above surface with contrasting colors.

2.03 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Manufacturer's optional accessories required by the project:
 - 1. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-

- bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- 2. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Signage with tactile characters to be mounted in accordance with ADA mounting heights and guidelines.

3.04 CLEANING

- A. General: Dispose of all waste material legally.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.06 SCHEDULE

- A. Building Address Sign: Dimensional numbers.
- B. Room and Door Identification Signs: In compliance with Local Code.
- C. Emergency Evacuation Signs: Panel Signs with printed map slot, surface mounted, locations as indicated and in compliance with local code.
- D. Maximum Occupancy Sign: In compliance with Local Code.

END OF SECTION

SECTION 10 28 00 TOILET

ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Rest Room 103 Accessories.
- B. Break Room 102 Accessories.
- C. Utility Room 104 Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry
- B. Section 09 21 16 Gypsum Board Assemblies
- C. Section 09 30 00 – Tiling
- D. Section 09 90 00 – Painting and Coating

1.03 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Sample: Submit 1 sample of each accessory, illustrating color and finish.
- C. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- D. Maintenance Data: For users operation and maintenance of system including:
 - 1. Methods for maintaining system's materials and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.04 MAINTENANCE MATERIAL

- A. As required by Section 01 78 23 – Operations and Maintenance Data.
- B. Keys: Provide 3 keys for accessories to Owner; master key all lockable accessories.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing the work of this

section with minimum 5 years' experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Specification is based on products listed as Basis of Design.
 - 1. Comparable products by one of the following are also acceptable.
 - a. American Specialties, Inc: www.americanspecialties.com.
 - b. Bradley Corporation: www.bradleycorp.com.
 - c. Bobrick Inc.: www.bobrick.com.
 - d. Or Approved Equal.
 - 2. Substitutions for products by manufacturers other than those listed above:
See Section 01 60 00 – Product Substitution Procedures.

2.02 DESCRIPTION

- A. Accessories to be installed in Break Room 102, Restroom 103, and Utility Room 104 as noted on the Drawings.

2.03 PERFORMANCE AND DESIGN CRITERIA

- A. Comply with ANSI/ICC A117.1, Americans with Disabilities Act (ADA).
- B. Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

2.04 MATERIALS

- A. Stainless Steel Sheet: ASTM A666, Type 304.
- B. Stainless Steel Tubing: ASTM A269, Type 304 or 316.
- C. Back paint, in accordance with Section 09 90 00 – Painting and Coating, where contact is made with building finishes to prevent electrolysis.
- D. Fasteners, Screws, and Bolts: Stainless steel, tamper-proof, security type.
- E. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.05 ACCESSORIES

- A. Breakroom 102, Accessories, Basis of Design:
 - 1. Paper Towel Dispenser and Waste Receptacle:
 - a. Product: Bobrick B-3944.

- b. Mounting: Recess-Mounted.
 - c. Capacity: 12-gal.
 - d. Material and Finish: 18-8, Type 304, 22-guage stainless steel, satin finish.
 - e. Mount operable part as required for to meet ADA and as noted on the Drawings.
 - 2. Soap Dispenser:
 - a. Product: Bobrick B-822.
 - b. Mounting: Counter-mounted.
 - c. Capacity: 34-fl oz.
 - d. Materials and Finish: Type 304 Stainless steel, satin finish.
- B. Restroom 103, Accessories, Basis of Design:
 - 1. Grab Bars:
 - a. Product: Bobrick Series B-5806 (horizontal) and B-5837 (two-wall ADA assist), sizes and configurations as indicated.
 - b. Mounting: Flanges with concealed fasteners.
 - c. Material: Stainless Steel, 18-gage, Type 304, satin.
 - d. Outside Diameter: 1-1/4-inches, uniform around curves.
 - 2. Lavatory Guards
 - a. Product: Lav Guard 2 E-Z manufactured by Truebro, Inc., www.truebro.com.
 - b. Antimicrobial (ASTM G21 and G22 0 growth) molded closed cell vinyl covers; 1/8-inch nominal wall thickness; 70-80 Shore A, Finish: smooth, high gloss, UV resistant, paintable.
 - 3. Seat Cover Dispenser:
 - a. Product: Bobrick B-221.
 - b. Mounting: Surface.
 - c. Capacity: 250 seat covers.
 - d. Exposed Finish: Stainless steel, No. 4 finish.
 - e. Lockset: Tumbler type.
 - 4. Sanitary-Napkin Disposal Unit:
 - a. Product: Bobrick B-35139.
 - b. Mounting: Surface mounted.
 - c. Material and Finish: Stainless steel, No. 4 finish, satin.
 - 5. Toilet Tissue Dispenser:
 - a. Product: Bradley Model 522.
 - b. Mounting: Surface mounted.
 - c. Capacity: Two roll toilet paper dispenser.
 - d. Color: Chrome plated die-cast zinc.
 - 6. Soap Dispenser:
 - a. Product: Bobrick B-822.
 - b. Mounting: Counter-mounted.
 - c. Capacity: 34-fl oz.
 - d. Materials and Finish: Type 304 Stainless steel, satin finish.

7. Paper Towel Dispenser and Waste Receptacle:
 - a. Product: Bobrick B-3944.
 - b. Mounting: Recess-Mounted.
 - c. Capacity: 12-gal.
 - d. Material and Finish: 18-8, Type 304, 22-guage stainless steel, satin finish.
 - e. Mount operable part as required for to meet ADA and as noted on the Drawings.
8. Mirrors:
 - a. Product: Bobrick B-1658 2436 Tempered glass with channel frame.
 - b. Mounting: Secured to concealed wall hanger with concealed Phillips-head locking screws locating in bottom of frame.
 - c. Glazing: Tempered per manufacturer.
 - d. Materials and Finish: Type 340 Stainless Steel, Polish finish.
- C. Utility Room 104, Accessories.
 1. Mop and Broom Holder with Shelf:
 - a. Product: Bobrick B-239.
 - b. Length: 34-inches.
 - c. Holders: Three spring loaded, rubber hat, cam type.
 - d. Material and Finish: Stainless steel, No. 4 finish.
 2. Wall Mount Shelves:
 - a. Product: Uline H-7498.
 - b. Length: 36-inches.
 - c. Depth: 12-inches.
 - d. Material: 16-guage Type 304 stainless steel.
 - e. Finish: Stainless steel, No. 4 finish.
 - f. Fasteners: Manufacturer's Hardware.

2.06 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.
- B. Provide and coordinate with all other trades adequate backing, blocking, or bracing to install the products level and plumb. Furnish inserts and anchoring

devices which must be set prior to the installation of other materials; coordinate delivery with other Work to avoid delay.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on Drawings.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8-inch.
- B. Maximum Variation From Plumb: 1/8-inch.

3.05 ADJUSTING

- A. Adjust and lubricate hardware for proper operation.

3.06 CLEANING

- A. Remove protective films and wipe out all enclosures. Follow manufacturer's recommendations for initial cleaning.
- B. Dispose of all waste material legally.

3.07 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Fire Extinguishers and Fire Extinguisher Cabinets.

1.02 SUBMITTALS

- A. Submit materials in accordance with Section 01 33 00 – Submittal Procedures. Furnish materials literature, product specifications and installation instructions for all products.
- B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- C. Shop Drawings: Indicate location of each fire extinguisher to be installed.
- D. Manufacturer's Installation Instructions: Indicate special preparation of substrate, installation and attachment methods, and perimeter conditions requiring special attention.
- E. Maintenance Data: For users operation and maintenance of system including:
 - 1. Test, refill or recharge schedules and re-certification requirements.
 - 2. Methods for maintaining system's materials and finishes.
 - 3. Precautions about cleaning materials and methods that could be detrimental to components, finishes, and performance.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in the manufacture of work specified in this section with minimum 5-years experience.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. As required by the manufacturer for a warrantable installation of the installed products to meet the Performance and Design Criteria.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. Fire extinguishers, surface mounted with accessories for proper use.
 - 1. 10lb extinguishers surface mounted at walls as indicated on the Drawings, with wall bracket as manufactured by Larsen's Manufacturing or comparable products by Ansul, Inc. or JL Industries, Inc. or Approved Equal.

2.02 PERFORMANCE AND DESIGN CRITERIA

- A. Portable fire extinguishers shall be selected and installed in accordance with this section and NFPA 10.
 - 1. 2015 IBC.906.2, General Requirements.

2.03 MATERIALS

- A. Fire Extinguishers:
 - 1. Multi-Purpose Dry Chemical Extinguisher.
 - a. Specification is based on MP Series by Larsen's Manufacturing Co.
 - 1) Comparable products by one of the following are also acceptable.
 - a) JL Industries, Inc: www.jlindustries.com.
 - b) Ansul, Inc: www.ansul.com.
 - c) Or Approved Equal.
 - 2) Substitutions for products by manufacturers other than those listed above: See 01 60 00 – Product Substitution Procedures.
 - b. Performance Criteria:
 - 1) Complying with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 2) Labeled by UL for the purpose specified and indicated.
 - 3) Class: A:B:C.
 - 4) UL Rating: 4A-80B:C.
 - 5) Extinguisher Model: Larsen's #MP5.
 - 6) Size: 10 pound.
 - c. Features:
 - 1) Finish: Baked polyester powder coat.
 - 2) Color: Red.
 - 3) Wall mount
 - 4) Signage: Red vertical letters wall mounted above the canister that reads "FIRE EXTINGUISHER", size of sign to be 4-inches by 12-inches.
- B. Fire Extinguisher Cabinets:
 - 1. General: Provide fire extinguisher cabinets suitable for housing one standard-size fire extinguisher as specified.
 - 2. Semi-Recessed: Trim with beveled or rounded edges in contact with wall surface. Provide rolled corners with approximately 2-1/2-inch wide trim, unless otherwise shown.
 - 3. Metal Gauge: Provide cabinets fabricated of the following minimum equivalent steel gauges:
 - a. Box: 20 gauge.
 - b. Trim Frame: 18 gauge.
 - c. Tubular Door Perimeter Frame: 20 gauge.
 - 4. Cabinet Color: Stainless Steel.
 - 5. Construction: One-piece tubular door frames, mitered and welded. One-piece metal trim frame, to suit cabinet style required. Weld all joints and grind smooth. Provide the manufacturer's standard steel

- box with white, baked enamel interior finish and #4 brushed 304 stainless steel exterior finish and trim.
- 6. Doors: Clear Tempered Glass panel, with inside latch and lock.
- 7. Door Hardware: Continuous-type hinge permitting door to open 180 degrees. Provide either lever handle with cam action latch, or door pull and friction latch.
- 8. Signage: Red vertical letters mounted on the cabinet door that reads, "FIRE EXTINGUISHER".

2.02 ACCESSORIES

- A. All accessory materials required by the manufacturer for a warrantable installation of the installed products in a manner that meets the Performance and Design Criteria.
- B. Manufacturer's accessories required by the project:
 - 1. Extinguisher Wall Bracket: Formed steel, galvanized and enamel finished.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions meet the manufacturer's requirements before starting work.

3.02 PREPARATION

- A. Prepare surfaces to receive work in accordance with manufacturer's instructions.
- B. Coordinate with all other trades for adequate backing, blocking, or bracing to install the products level and plumb. Furnish inserts and anchoring devices which must be set prior to the installation of other materials; coordinate delivery with other Work to avoid delay.

3.03 INSTALLATION

- A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.04 ADJUSTING

- A. Adjust and lubricate hardware for proper operation.

3.05 PROTECTION

- A. Protect installed work as required by the manufacturer to maintain product performance, design criteria and warranty.

3.06 CLEANING

- A. Remove protective films and wipe out enclosure. Follow manufacturer's

recommendations for initial cleaning.

- B. Dispose of all waste material legally.

3.07 SCHEDULE

- A. (FEC): Recessed Cabinet with Multi-Purpose Dry Chemical Extinguisher, Type: A:B:C, Capacity: 10 pound, location as noted on the Drawings.

END OF SECTION

SECTION 22 00 10

GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, and Division 01.
- B. This section of the specification applies to the entire mechanical work, both interior and exterior, as specified herein after and shown on the plans.
- C. This Contractor is responsible for coordination with all other trades.

1.02 SCOPE

- A. All services to within five (5) feet of the building shall be provided as shown on plans, and final connections to these services shall be made by the Mechanical Contractor.

1.03 DEFINITIONS

- A. The term "approved equal" means final approval by the Owner's representative of a material or piece of equipment substituted for that which is shown in the specifications or plans.
- B. The term "provide" means the furnishing and installing of equipment (including connections and appurtenances) complete and ready for use.
- C. The terms "Mechanical Contractor (MC)" and "Electrical Contractor (EC)" as used in these Specifications or on the Contract Drawings, refer to those subcontractors working under the direction of the "General Contractor (GC)."

1.04 INTENT OF DRAWINGS

- A. The drawings are diagrammatic and do not show the exact details and locations, nor all offsets in piping. Contractor shall provide additional fittings, offsets and extensions in piping and related mechanical insulation as required to meet the intent of the documents and shall include these items in his bid. Contractor shall also include in his bid provisions to relocate or shift piping where conflicts exist with Structural, Architectural or Electrical.
- B. Refer to the complete set of Architectural, Structural, Electrical, and Civil Plans and Specifications for additional details of the work. Review Plans and Specifications of other trades to identify other requirements. Discrepancies shall

be reported to the Owner's representative immediately before ordering material or beginning work.

1.05 COORDINATION

- A. Examine the Architectural, Civil, Structural and Electrical drawings before work is started. Consult with each of the other Contractors regarding locations and spaces required for work and lay out work to avoid interference. Maximum clearance shall be maintained for service access and maintenance of all equipment. Failure to coordinate shall be justification to require Contractor, at his own expense, to move his work to provide the necessary space for the other contractors.
- B. Mechanical systems have space priority as follows, listed with highest priority first: Graded Drainage Piping, then Ductwork, Drainage Vents, Domestic Water Piping. MC to make certain that priority access is maintained. This shall be coordinated by the GC and MC without assistance from Owner's representative, Engineer, or Architect.
- C. Contractor shall be responsible for his own coordination between all other trades. Development of Shop Drawings shall be a collaborative effort between the General Contractor, Mechanical Contractor, Electrical Contractor and all other subcontractors working on the project. Shifting of piping, ductwork and other mechanical items shall be the responsibility of the Team to maintain

1.06 WORK IN OTHER SECTIONS

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

1.07 CODES AND REFERENCES

- A. Codes and Standards listed shall be the most current issue as adopted by the Local Jurisdiction. In the event of a conflict of codes, the most stringent code will apply.
 - 1. International Building Code (IBC)
 - 2. Uniform Plumbing Code (UPC)
 - 3. International Mechanical Code (IMC)
 - 4. Washington State Energy Code
 - 5. SMACNA Duct Construction Standards, Metal and Flexible
 - 6. National Electrical Code (NEC)

1.08 PERMITS AND FEES

- A. Obtain and pay for all permits, licenses and construction or utility fees. Furnish final certificate to Owner showing compliance with code requirements.

1.09 SCHEDULING

- A. Comply with requirements of General Specifications.

1.10 PRIOR APPROVALS

- A. Specifications have been written around equipment and material selected for this project based on quality, size, capacity, and performance required to meet building design criteria. Any equipment and/or material used in this project, that is not as specified, must have prior approval from the Owner's representative.
- B. Request for Approval must be submitted with substitution request form included in Division 0 to Owner's representative a minimum of 10 calendar days prior to bid date. This letter shall be accompanied with complete information regarding items to be substituted.
- C. Those items that receive prior approval will be listed in the Mechanical Addenda.
- D. Supplier, and/or Mechanical Contractor, shall be responsible for ensuring that substituted material or equipment is of the same size, quality, capacity, weight, and electrical characteristics as that specified. Any changes and costs required during construction, due to contractor's/supplier's neglect to properly select substituted equipment, shall be paid by the contractor/supplier.
- E. Prior approval to bid does not mean automatic final approval of material or equipment by the Owner's representative. Final approval will be given after final submittal data has been presented to Owner's representative, with complete information regarding weights, capacities, size, electrical requirements and quality.

1.11 MATERIAL AND MATERIAL SUBMITTALS

- A. All material used on the project shall be new material and free from defects. This Contractor shall submit catalog data and engineering data, on all equipment as specified or having received prior approval.
- B. All Plumbing Fixtures, Trim, Piping and Valves in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards, or be NSF-61-G certified to all requirements of NSF/ANSI 61 (health effects) and all requirements of Annex G and NSF/ANSI 372 (lead content) via third-party testing and certification.
- C. Material and equipment specified is designated by various manufacturer's catalog numbers. Acceptable alternate manufacturers are also listed. Such manufacturers are exempt from the 10-day prior approval clause of these specifications, but must submit standard submittal data for final approval as otherwise noted.
- D. Submittal shall be arranged in numerical order, according to specification section number and item number. Submittal shall be in PDF format complete with labeled bookmarks (minimum one per specification section)

- E. Submittal shall be as follows: Before ordering or installing any of the materials, this Contractor shall submit copies of complete information on the materials to be used on the project. Submittal shall include, but not be limited to, the following.
 - 1. Contractor's Cost Breakdown.
 - 2. Complete List of Subcontractors and Suppliers.
 - 3. Pipe, Valves and Specialties
 - 4. All Plumbing Fixtures.
 - 5. All pumps for Plumbing.
 - 6. Water Heaters.
 - 7. Insulation.
- F. The Owner's representative will return one set of this submittal to the contractor showing any corrections, additions, and/or deletions. This Contractor shall resubmit those items that need to be corrected or added.

1.12 CONTRACTOR'S COST BREAKDOWN

- A. Mechanical Contractor shall submit, a cost breakdown of the major portions of his work, pursuant to the following outline.
 - 1. Job organization and submittals.
 - 2. Outside site utilities.
 - 3. Plumbing rough-in.
 - 4. Plumbing fixtures.
 - 5. Plumbing piping and insulation.
 - 6. Plumbing specialties.

1.13 RECORD (AS-BUILT) DRAWINGS

- A. This Contractor shall maintain a set of Contract Drawings at the site on which the actual installed location of piping, equipment, etc., shall be shown in a legible, neat manner. This set of plans shall show actual dimensions (including depth of bury) of underground piping from construction lines, so they can be readily found after covering. Record drawings shall be the same size as contract drawings. This set of plans shall be submitted for final approval. Drawings shall be one full size set, one half size set and on a USB flash drive in color PDF format. The contractor shall be ready for review of the on-site as-builts monthly prior to submitting his billing. Failure to have drawings available for review may delay monthly billings.

1.14 OPERATING INSTRUCTIONS

- A. Operate all systems through complete cycles in the presence of designated Owner's representative. Give instructions for operation, care and maintenance. All systems shall be operated through complete operating cycles for a minimum period of 7 days in conjunction with the designated Owner's representative before acceptance.

1.15 TRAINING

- A. The Mechanical Contractor shall digitally record all Owner Mechanical training sessions and shall provide copies on a USB flash drive. Training sessions shall be provided for all mechanical systems. Three copies shall be turned over to the Owner at the completion of the project.

1.16 OPERATION AND MAINTENANCE MANUALS (O&MS)

- A. General: Provide one preliminary searchable PDF set of Operation and Maintenance Manuals including maintenance information and parts list furnished by the manufacturer with the equipment, together with supplementary drawings where necessary, to itemize serving and maintenance points. Include the Valve Tag list(s) as posted in the Mechanical spaces. Include filter maintenance, methods of operation, seasonal requirements, manufacturer's data and warranty forms. Warranty forms are to be located in the front of the manuals as well as in each applicable section. Provide address and 24-hour phone number of the firms responsible under warranty. Items requiring service or correction during the warranty period shall be serviced within 24-hours of notification by Owner. Data in manuals shall be neat, clean copies, with operation and maintenance instructions for each item of equipment installed. Drawings shall be accordion folded. An index shall be provided with all contents listed in an orderly presentation with bookmarks according to specification section.
- B. Number of Copies: A preliminary set of the O&M Manuals shall be submitted for approval. After this set has been approved, One hard copy and 3 electronic copies on USB flash drives shall be submitted.
- C. Hard Copy Binding: Organize operating and maintenance data into suitable sets of manageable size. Copies shall be submitted in 3-ring binders. Covers shall include the name of the Job, Owner, Architect, Engineer, Contractor, and the year of completion. The back edge of the binder shall include a label with the name of the Job, the Owner and the year completed. Each copy shall have a typewritten index and tabbed dividers between equipment categories. Binders are to be no more than 80% full; binders that are over 80% full will be sent back for dividing into additional binders.

1.17 CERTIFICATIONS

- A. Provide written certification that work has been fully completed in strict accordance with Plans and Specifications and request final inspection.
- B. Provide written certification that Contractor will replace materials and workmanship that prove defective for one (1) year after date of acceptance or extended warranty as listed in individual sections.
- C. Provide written certification of inspection from the Authority Having Jurisdiction, stating that all work has been inspected, accepted, and approved as complying with existing governing ordinances and codes.

- D. Provide written certification that Owner's representative has been fully instructed in the operation and function of all mechanical systems.
- E. Provide copies of certifications in the O & M Manuals.

1.18 DOCUMENTS

- A. Present the following documents to the Owner's representative prior to final acceptance of buildings. Final payment of the Contract will be contingent upon receiving these documents:
 - 1. Record (as-built) drawings.
 - 2. Operation and Maintenance Manuals (3 sets).
 - 3. Final material submittal.
 - 4. Warranties and Extended Warranties.
 - 5. Approved Final Balancing logs. .
 - 6. State of Washington certification of all pressure vessels installed on the project. Affix a copy to each tank.
 - 7. Final certificates of inspection and code compliance.
 - 8. Domestic water test results.
 - 9. RPBF device tests.
 - 10. All applicable forms required by these specifications.
 - 11. Provide copies of the above documents in O & M Manuals.

1.19 WARRANTY

- A. All Plumbing systems, and all parts thereof, shall be warranted (parts and labor), for a period of one (1) year after the date of substantial completion as determined by the documentation.
- B. Contractor shall repair or replace, to the satisfaction of the Owner's representative, any defective material, equipment, or poor workmanship which may show itself during this warranty period.
- C. Test and Balance shall be warranted for two (2) years total, from date of final acceptance.

1.20 MECHANICAL ACOUSTICAL REQUIREMENTS

- A. The noise criteria (NC) end resultant for each space shall be per Code, as accepted by Local Jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SUBMITTAL

- A. Owner's representative's review of submittals is for general conformance with the design concept and Contract Documents. Marking or comments shall not be construed as relieving the Contractor from compliance with the project Plans and Specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and assembly and for safe performance of his work.

END OF SECTION

SECTION 22 00 20

BASIC MATERIALS AND METHODS FOR PLUMBING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General requirements for basic materials and methods.

1.02 REFERENCES

- A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- B. "Seismic Restraint Manual Guidelines for Mechanical Systems" by Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

PART 2 - PRODUCTS

2.01 GENERAL

- A. See specific sections for this requirement.

2.02 PRODUCT TESTING

- A. Any piece of equipment used in this project and hereinafter specified which, by its nature, requires electrical connection, such as pumps, water heaters, booster heaters, etc., must be provided with an approval label from one of the agencies hereinafter listed.
- B. Approval of agency must be for the total package (approval of individual components not acceptable). All labels must be located outside of equipment and shall be visible to inspector. Comply with all requirements of RCW 19.28.010 and NEC Sections 90-7 and 110-3 (1993).
- C. It is the responsibility of the Mechanical Contractor or the equipment supplier to meet the requirements of this section. Any agency costs to provide appropriate label for a piece of equipment must be included in this bid. Failure by Mechanical Contractor or supplier to obtain approval labels prior to bid shall be sufficient cause for the Mechanical Contractor/supplier to obtain all such labels at no additional cost to Owner. The following is a list of approval testing laboratories:
 - 1. Underwriters Laboratories, Inc., www.ul.com
 - 2. Canadian Standards Association, www.csagroup.org
 - 3. Factory Mutual Systems, www.fmglobal.com

4. MET Electrical Testing, www.metlabs.com
5. Intertek Testing, www.intertek.com

2.03 PRESSURE VESSELS

- A. At the completion of the project, the Contractor shall provide State of Washington Certification of all pressure vessels installed on the project. Affix certification on the vessels and provide a copy in the O&M Manual.

2.04 FIRE INTEGRITY - PENETRATION SEALING SYSTEMS

- A. Manufacturers
 1. 3M Fire Products
 2. Holdrite
 3. Approved equal
- B. The penetration sealing systems shall be provided with F-Rating and/or T-Rating as required by IBC Section 714.3 and 714.4. Penetrations include the following:
 1. Through-penetration firestopping in fire-rated construction.
 2. Construction-gap firestopping at connections of the same or different materials in fire-rated construction.
 3. Construction-gap firestopping occurring within fire-walls, floor or floor-ceiling assemblies.
 4. Construction-gap firestopping in smoke partitions.
 5. Through-penetration smoke stopping in smoke partitions.
 6. Construction-gap smoke stopping in smoke partitions.
 7. All and piping penetrating mechanical spaces, mechanical mezzanines, mechanical lofts, mechanical boiler rooms, or other mechanical spaces, shall be fire caulked, even if the walls are not rated. Visible piping penetrations shall be covered by split chrome-plated floor and ceiling plates.
- C. All products shall be listed in Underwriters Laboratory Fire Resistance Directory.
 1. Through-penetration firestop devices (XHCR).
 2. Fire resistance ratings (BXUV).
 3. Through-penetration firestop systems (XHEZ).
 4. Fill, void or cavity material (XHHW).
- D. All material shall be tested per American Society for Testing and Material Standards, ASTM E814: Standard test method for fire tests of through-penetration firestops.
- E. Firestopping for penetrations and voids shall be UL-tested systems.

2.05 HANGERS

- A. Manufacturers:
 1. Grinnell
 2. Michigan Hanger

3. Tolco
 4. PHD
 5. Anvil
 6. Holdrite
 7. Approved equal
- B. Provide all anchors, hangers and all supports for piping and equipment included in contract.
- C. It is the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially-accepted pipe hangers and accessories.
- D. All pipe hangers and supports shall conform to the latest requirements of ASME B31.1 Code for Pressure Piping , and Manufacturers Standardization Society Documents MSS SP-58 and MSS SP-69.

2.06 INSERTS AT HANGERS AND SUPPORTS

- A. Manufacturers:
1. Holdrite
 2. Buckaroos
 3. Cooper
 4. Metro Supply Company
 5. Value Engineered Products, Inc.
 6. Hydra-Zorb Klo-Shure 7-series or 8-series strut-mount and Clevis
 7. Approved equal
- B. Insulated pipe inserts shall be provided at hanger, support, anchor, and guide locations on piping requiring insulation. The insert is to consist of either hydrous calcium silicate or polyisocyanurate foam insulation (urethane) encircling the entire circumference of the pipe with a 360-degree PVC (1/16" thick) or galvanized steel jacket (20 gauge minimum). Inserts are to be installed on piping during piping installation, by the Piping Contractor. Provide continuous insulation vapor barrier. Seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor retarder mastic.
- C. For elastomeric insulation, provide Hydra-Zorb Klo-Shure 7-series 8-series strut-mount or Clevis Hanger Insulation Couplings or approved equal.
- D. Insulation and covering shall meet the flame spread index and smoke developed index as noted in the International Building Code.
- E. Insert thickness shall match Code-required insulation thickness as a minimum.
- F. Provide pipe covering protection saddle for piping on rollers; Anvil figure 160 through 166A or approved equal.
- G. Inserts for piping in plenums shall have appropriate flame/smoke spread rating.

2.07 SUPPORT FOR EXTERIOR GROUND MOUNTED PIPING

- A. For piping run across grade, provide the a support system, detail the type and locations of the different configurations required, and submit for approval prior to starting work:
- B. System shall be securely mounted to concrete with unitstrut or other support material where located in equipment enclosure.
- C. Secure piping to the support system.

2.08 ELECTRIC MOTORS

- A. Minimum efficiencies of electric motors shall comply with the Washington State Energy Code.

2.09 ACCESS DOORS AND PANELS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Milcor
 - 3. Mifab
 - 4. Approved equal.
- B. 16 gauge steel door and frame with concealed hinge and cylinder lock. Provide matching latches/locks keyed the same for multiple panels in a project. When "B" dimension is 24" or more, provide additional latches at the top and bottom of door. Provide finish and material as noted in Part 3 – Execution.

2.10 VIBRATION AND SEISMIC CONTROLS

- A. Manufacturers:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries
 - 3. Amber-Booth
 - 4. I.S.A.T.
 - 5. Flexicraft
 - 6. Twin City Hose
 - 7. Approved equal.
- B. General
 - 1. Size anchoring bolts to withstand lateral seismic shear and isolate bolts from direct contact with structure using bolt isolation washer and bushing.
 - 2. Piping in connected to vibrating equipment shall be supported from resilient ceiling hangers or from floor mounted resilient supports.
- C. Pipe Isolation - General
 - 1. Motion Restraint Snubber: seismic restraint cable, rod clamp for standard 1-5/8" x 1-5/8" unistrut, and clevis cross brace.

- D. Piping not requiring sway bracing is as follows:
 - 1. Piping suspended by hangers 12" or less in length measured from the top of the pipe to bottom of hanger support where the hanger is attached.

PART 3 - EXECUTION

3.01 LAYING OUT WORK

- A. Locate all general reference points as established by the General Contractor and take such action as is necessary to prevent their destruction; lay out work and be responsible for all lines, elevations, grading for utilities and other work executed under the Contract. Exercise proper precautions to verify figures shown on drawings before laying out work, and be responsible for any errors resulting from failure to exercise such precaution. The coordination of the utility installation with the final site grading and elevation by the General Contractor shall be the responsibility of this Contractor. Locate existing utility lines which will be affected by the building location before any footing work begins. Report conflicts with the Plans to the Owner's representative for adjustment before proceeding with the work. Failure to follow this instruction will result in the Contractor being required to alter his work at his own expense.

3.02 ELECTRICAL WORK

- A. All electrical work performed under this Section of the Specification shall conform to all applicable portions of the Electrical section of the Specifications, and shall conform to all applicable Codes.

3.03 WORKMANSHIP

- A. Furnish and install all equipment for a neat and finished appearance. If, in the judgment of the Owner's representative, any portion of the work has not been installed in a workmanlike manner, or has been left in a rough, unfinished manner, Contractor will be required to remove and reinstall the equipment, and patch and paint surrounding surfaces in a manner satisfactory to the Owner's representative, without any increase in cost to the Owner.

3.04 EXCAVATION - GENERAL

- A. Perform all necessary excavation, shoring and backfilling required for the proper installation of work inside the buildings and premises, or outside as may be necessary. Slope sides of excavation to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Sewer trenches shall be excavated to the grade with the bottom rounded to the outside of the sewer piping. Bell holes shall be hand excavated to ensure that piping rests for its entire length upon the bottom of the trench.
- B. Excess excavation shall be backfilled with gravel or sand and mechanically

compacted to give full support to the piping. In case of sewer lines in rock excavation, the excavation shall be made at least 6" deeper than required and backfilled with sand to outside invert grades to provide cushion. No underground lines shall be covered until the installation has been approved by the Owner's representative and the Authority Having Jurisdiction. Maintain sides and slopes of excavations in safe condition until completion of backfilling. All backfill shall be thoroughly compacted.

- C. No cinders shall be used for backfilling where steel, iron or copper piping is used. All trenches near or under footings shall be cut only after approval of the Owner's representative, and all backfilling of such trenches shall be according to his direction.
- D. All items of grading which will in any manner affect the bearing capacity of the soil foundations upon which will be placed floor slabs, walls, column footings or pipe beds shall be performed to the satisfaction of the Owner's representative. All soil foundation areas which will in any manner support any of the above-stated construction will be compacted by the use of mechanical tampers to at least 95% of the maximum density of the soil foundations as determined by the compaction control test, in accordance with the "Method of test for Moisture Density Relations of Soils, ASTM Designation D1557." The moisture control at the time of compaction shall be uniform throughout the area and shall not vary more than 5% above or below the optimum moisture content as determined by the above described " Compaction Control Test." Place fill in 8" loose layers, each layer compacted.
- E. Division 31, (31 23 16 - Excavation, 31 23 23 Fill, 31 26 16.13 Trenching), shall provide Excavation, Fill and Trenching for the Mechanical Contractor, as needed to complete his work.

3.05 EXCAVATION DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations, and from a flooding project site and/or surrounding area.
- B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
- C. Establish and maintain temporary drainage ditches and other diversions, outside excavation limits to convey rain water and water removed from excavations to collection points or run off areas. Do not use trench excavation as temporary drainage ditches.

3.06 EXCESS EXCAVATION MATERIAL

- A. Dirt and debris from trench excavation shall be disposed of by this Contractor, as

directed by the Owner's representative.

3.07 PIPING INSTALLATION

- A. Lay piping in straight lines with uniform slope, leave no pockets. Care shall be taken to keep all foreign materials out of the piping during installation. Where ground water is present, provide suction pumps to keep trenches free of water, and cap ends of piping exposed to ground water when work is interrupted.
- B. All underground piping used for the distribution of domestic water systems and waste drainage systems located outside the building perimeter shall be buried a minimum of 36" from finish grade to top of piping.
- C. Piping run above the floor SHALL NOT BE LOCATED OVER ELECTRICAL PANELS OR SWITCHBOARDS, except where located above a structural ceiling, or with drain pans approved by the AHJ. This piping includes, but is not limited to, waste and vent and domestic water lines.
- D. Isolation Valves:
 - 1. Provide isolation valves on inlets and outlets of all major pieces of equipment, to facilitate serving and removal of such equipment without the necessity of draining the associated system. Provide whether or not shown on Plans.
 - 2. Provide isolation ball or butterfly valves with positive shutoff for all hot water, cold water and hot water recirculation piping serving restrooms.
 - 3. Provide isolation ball or butterfly valves at all branches off the mains.
 - 4. Provide access panels to isolation valves located above hard ceilings.
- E. Circuit balance valves: Hot water recirculation lines are to have a circuit balance valve at each branch and restroom in addition to the isolation valve. Provide whether or not shown on Plans.
- F. Do not solder within 12" of valves, flanges, etc., manufactured from any bismuth alloy.

3.08 OPENINGS IN PIPING

- A. Keep all openings covered tightly with plastic during the work.

3.09 PIPE SLEEVES

- A. General: Provide pipe sleeves for piping passing through foundations, walls, floors, partitions, and roof to allow piping to pass freely through.
- B. Foundation Walls: Where piping passes through walls below finished grade, but does not enter the building spaces, the sleeves shall be Schedule 40 galvanized steel pipe. Provide a modular seal between the sleeve and the piping.
- C. Building Walls (Below Grade) and Floor Slabs: Where piping passes through building walls below grade, and floor slabs on grade or below grade, the sleeves

shall extend a minimum of 1" inside the building wall or above the finished floor level, and shall be made watertight and gas tight by the appropriate modular seal. Sleeves shall be Schedule 40 galvanized steel pipe. If the sleeve and modular seal are subject to trapping water on the top side, pack with water resistant foam and caulk with flexible caulking or grout.

- D. Building Walls and Floor Slabs (Above Grade) - New Construction: Where domestic hot and cold water and hot water circulation piping passes through concrete walls or floors within the building, the sleeves shall be of sufficient strength to withstand the pressure and concrete pouring operation without deforming or rupturing. Sheet metal ductwork with end slit and formed into flanges is not acceptable. Sleeves shall extend 1" above the finished floor. Sleeves in walls shall be flush on both sides.
- E. Piping Subject to Expansion: Where piping is subject to motion due to expansion, such as domestic hot water piping, the sleeve shall be made large enough to allow free motion. When piping passing through is insulated, the sleeve shall be large enough to permit the covering to pass through.

3.10 WALL/FLOOR PLATES AND ESCUTCHEONS

- A. Where piping passes through any wall, floor or ceiling, it shall be fitted with chromium-plated steel escutcheons, with suitable set screws or other approved holding device. Where extended sleeves are necessary, the plates shall be of sufficient depth to cover the sleeves.

3.11 PIPE HANGERS AND SUPPORTS

- A. Where thermal movement in the pipe line will occur, the pipe hanger assembly must be capable of supporting the line in all operating conditions. Accurate weight balance calculations shall be made to determine the supporting force at each hanger location, in order to prevent excessive stress in either pipe or equipment connections.
- B. Where piping is to be supported from building steel, beam clamps shall be used. Beam clamp selection shall be for the required load and the configuration of the steel at the point of attachment. Drilling holes in the steel for hanger rod will not be permitted unless approved by the Structural Engineer. Use only adjustable side beam clamps (Type 25); standard beam clamps are not acceptable.
- C. Riser Clamps (Vertical Piping): Piping shall be supported at each floor with a riser clamp or at sufficient intervals to carry the weight of the piping and its contents. Stacks shall be supported at their base by a concrete pier or by a suitable hanger located on the horizontal run, close to the riser. Riser clamp extensions shall rest on the building structure where possible; auxiliary steel supports shall be provided where it is impractical to rest directly on the building structure.
- D. Angle Clips: Where piping is to be supported from building wood structure, angle clips shall be used with lag bolts sized to support the load in shear. Any attachment

to wooden structural members shall be subject to the approval of the Structural Engineer.

- E. Hanger Rods: Hanger rod size shall be selected on the basis of loading from the following table:
- | | |
|------|--------|
| 3/8" | 610# |
| 1/2" | 1,130# |
| 5/8" | 1,810# |
- F. Hangers shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing. **DO NOT BEND RODS.**
- G. All rods shall be electro-plated to prevent corrosion.
- H. All rods shall be double-nutted, on both ends if applicable, and excess rod on the bottom shall be cut flush and ground for safety.
- I. Hanger Spacing: The maximum allowable spacing for pipe hangers shall be in accordance with the following. Where concentrated loads of valves, fittings, etc., occur, closer spacing will be necessary and shall be based on the weight supported and recommended loads for the hanger components.
1. Spacing: Cast Iron Hubless - Shielded Coupling:
 - a. Horizontally: Every other joint, unless over 4', then support each joint. See notes 1, 2, 3, and 4.
 - b. Vertically: Base and each floor not to exceed 15'.
 2. Copper Tube and Piping - Soldered, Brazed or Welded.
 - a. Horizontally: 1-1/2" and smaller, 6'; 2" and larger, 10'.
 - b. Vertically: Each floor, not to exceed 10'. See note 5.
 3. Notes For Above:
 - a. Support adjacent to joint not to exceed 18".
 - b. Brace at not more than 40' intervals to prevent horizontal movement.
 - c. Support at each horizontal branch connection.
 - d. Hangers shall not be placed on the coupling.
 - e. Vertical water lines may be supported in accordance with recognized engineering principles with regard to expansion and contraction when first approved by the Authority Having Jurisdiction.
 - f. See the appropriate IAPMO Installation Standard for expansion and other special requirements.
- J. Hangers - Horizontal Piping:
1. General: All hangers shall be provided with means of vertical adjustment. The following schedule shall be followed to select acceptable hangers for the type of service.
 - a. Non-Insulated Steel Piping:
 - 1) Adjustable Split Ring Swivel Hanger
 - 2) Adjustable steel Band Hanger

- 3) Clevis Hanger
2. Trapeze Hangers: Where piping is grouped in parallel, provide manufactured strut or trapeze hangers consisting of two steel angles bolted back to back, with space between for a hanger rod at each end. Where the length of angles is greater than 24", there shall be three rod supports. Piping shall be able to move independently, and hanger spacing shall be dictated by the smallest pipe.
3. Brackets and Racks: Where piping is run adjacent walls or steel columns, welded steel brackets shall be used as base supports. Multiple pipe racks or trapeze hangers shall be designed and fabricated to suit conditions.
4. Anchors, Guides and Sliding Supports: Shall be as shown on the drawings or as necessary to prevent excessive stress in either piping or equipment.
5. Auxiliary Steel: All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook, furnished by the Mechanical Contractor, and shall receive one shop coat of primer paint.
6. Submittals: The Contractor shall submit, prior to installation, the following information and data for approval.
 - a. Data Sheets on all cataloged items to be used.
 - b. Sketches covering all specially designed hanger assemblies and fabrications.

3.12 CUTTING AND PATCHING (NEW WORK)

- A. Furnish dimensions and locations of openings to other Contractors doing the work. Provide ample time to avoid delays and unnecessary labor. Cutting and patching made necessary to admit work, repair defective material or workmanship, or by neglect to anticipate proper requirements, shall be done by the General Contractor. at the expense of the Mechanical Contractor.

3.13 ACCESSIBILITY

- A. Locate valves, traps, damper operators, etc., so as to be easily accessible in mechanical spaces or through access panels, specified hereinafter. Otherwise, obtain Owner's representative's approval of location.
- B. Any equipment requiring maintenance clearances for servicing of filters, motors, compressors, etc., shall be carefully coordinated to avoid servicing problems. Failure of Contractor to comply with this requirement shall be sufficient cause for Contractor to make all necessary changes at no cost to the Owner. To avoid problems with interpretation of the NEC, allow 42" for all electrical clearances.

3.14 ACCESS DOORS AND PANELS

- A. Locations of panels shall be carefully selected during construction, so as not to be located behind cabinets, etc. Coordinate closely with the Architectural and Electrical Plans before installing panels.
- B. In areas on painted walls, etc., access panels shall be prime-coated and painted

by the General Contractor; install before surrounding surfaces have been painted. In other finished areas such as on ceilings, all access panels shall have the same type of finished surface as that of the surrounding area.

- C. Verify with the Owner's representative location and finish prior to ordering; failure to get the Owner's representative's approval may result in replacement of access panels at the Mechanical Contractor's expense. Minimum size of access doors is 12" x 12"; actual size depends on the specific circumstance, and panel shall be large enough to accomplish replacement or repair of the item requiring access. The Owner's representative shall have the final say on whether or not the access is of sufficient size.
- D. Provide access panels for all wall cleanouts on drainage piping and concealed valves for all piping.
- E. Doors shall have cylinder lock latches, all keyed alike.
- F. Provide fire-rated access doors for one-hour or two-hour rated walls and ceilings; units shall be UL labeled.

3.15 MECHANICAL ACCESSES

- A. Provide suitable access to all mechanical equipment requiring servicing, maintenance, replacement, or repair. In concealed spaces where access has not been provided by the Architect by means of doors, hatchways, walkways or other means, provide wall or ceiling access doors of a type suitable to the Owner's representative, sized to provide easy access to all equipment. Location of such doors shall be coordinated with the work of the other trades, to avoid conflict therewith, and such locations shall be approved by the Owner's representative prior to installation of access panels.

3.16 PAINTING, TAGS, ETC.

- A. Field painting of all equipment, piping etc., located in and exposed in occupied spaces, shall be by the General Contractor. See Architectural painting specification.
- B. Identification Tags: Provide identification tags for each main shut-off and control valve throughout the building indicating the system served. Tags shall be black phenolic plastic with white engraved inscription attached with chrome chain.
- C. Provide valve tag lists under glass. Locate as directed by the Owner's representative.
- D. Each major item of Equipment shall be provided with the name of the item, i.e., Water Heater No. 1, etc., in labels of black phenolic plastic with white engraved inscription. Minimum size of lettering is 1" with a maximum of 2". Select appropriate sizes for the size of the equipment being labeled. Align labels with edges of equipment and locate labels so as to be visible.

E. Pipe Markers:

1. Piping throughout the building shall be equal to Brady Corporation No. B-946, M.S.I. No. MS-900, meeting or exceeding ANSI A13.10-1981. Pipe markers shall consist of two wraps of arrows in the direction of flow, color, and wording as indicated in the following schedule. Stencils shall be visibly located and spaced on maximum 20'-0" centers for long straight pipe runs. Stencils shall be located on both sides of a wall, within the first 3'.
2. Color Code Schedule: (Service, Color, Stencil)

Domestic Cold Water	Green C.W.
Domestic Hot Water	Yellow H.W.
Domestic Hot Water Recirc.	Yellow H.W.C.
Waste and Vent Lines	Yellow D.W.V.

3.17 TEST PLUGS AND GAUGES

- A. Pressure or temperature test plugs shall be installed on inlet and discharge of all pumps, even if they are not shown on Plans.
- B. Pressure or temperature test plugs shall be installed adjacent all temperature and/or pressure sensors, even if they are not shown on Plans.
- C. A minimum of (1) compatible pressure gauges (including pressure gauge adapters) and (1) compatible temperature gauges shall be provided.
- D. P&T test plugs included on other devices that serve the same purpose and that provide the same information are acceptable; duplicates are not required.

3.18 FIRE INTEGRITY

- A. All penetrations of fire-rated walls, ceilings, roofs or floors by piping must be protected by appropriately-rated assemblies and caulking to maintain integrity of structure.

3.19 CLEANING UP

- A. Comply with requirements of the General Specifications.
- B. Remove tags, labels, etc., from all plumbing fixtures. Clean all fixtures and trim.

3.20 CAULKING

- A. Caulk all openings and flash around all piping and equipment passing through roof, floor, and walls. All caulking shall be water resistant. See also Paragraph "Fire Integrity" for rated wall, ceiling, roof, or floor penetrations.
- B. All piping penetrations of walls, ceilings, and floors shall be caulked. A chrome-plated steel escutcheon plate shall be installed at each visible pipe penetration of walls, ceilings, or floors.

3.21 OPERATION OF EQUIPMENT AND SYSTEMS

- A. Contractor is responsible during all periods of balancing and testing. Provide temporary utilities as required.

3.22 TESTS, ADJUSTMENTS AND INSPECTION

- A. Test all work thoroughly and systematically, both during construction and after completion. Notify Owner's representative 48 hours in advance of all tests. Tests shall be maintained until approved. Tests shall be as hereinafter specified.
- B. The Contractor shall test the completed installation as in regular service. Any defects or imperfections that may show up are to be promptly corrected. The Contractor shall guarantee the entire system and all parts thereof for a period of one year from date of final acceptance. The Contractor shall repair or replace any part which may show signs of failure during that time, if such failure, in the opinion of the Owner's representative, is due to imperfections in material or to improper workmanship.
- C. No system, whether prescribed for testing or not, shall be covered or concealed below ground, in walls, in ceiling spaces, or generally from ease of viewing, without first notifying the Owner's representative. Failure to notify the Owner's representative for inspection of concealed systems shall be cause to require this Contractor to uncover and recover such systems at no additional cost.
- D. A log of all tests shall be kept. The log shall note dates, time of day test started, system or portion of system tested, length of test, test results, and who witnessed the test (AHJ, Owner's representative, or GC). Contractor shall include legible names of witnesses. Contractor to submit a copy of the contractor's test log monthly to the Owner's representative.
- E. Review the project to determine when final inspection is appropriate and advise Owner's representative. Mechanical Contractor is required to complete his work before requesting final inspection.
- F. See specification section of piping used for test methods or procedures used.

3.23 FINAL INSPECTION

- A. This Contractor shall thoroughly review and inspect the project to determine when final inspection is required, and shall so advise the Owner's representative. It shall be understood that the work is to be essentially complete. If such is not the case and more than one final inspection and one backcheck are necessary, this Contractor may be billed for the additional back checks at the then governing rate for the personnel involved. The final inspection punchlist shall be legibly signed on a copy of the punch list by a person responsible for the trade involved, and transmitted to the Owner's representative, before the backcheck will be scheduled.

3.24 PROTECTION AND CLEANING

- A. All equipment and material installed by this Contractor shall be properly protected

from damage during the course of construction. Enamelware or china fixtures which are plastered around and/or over shall be protected with heavy, thoroughly-secured, wrapping paper. All fixtures and equipment shall be thoroughly cleaned before final inspection. Remove all pasted paper labels from plumbing fixtures.

3.25 SPECIAL PROTECTION

- A. Exercise maximum precaution to protect the building and equipment from damage of any kind, and in particular, prevent water and dust seepage into new equipment.

3.26 BALANCING WORK

- A. Provide Testing, Adjusting and Balancing as required in this section of the specification.

3.27 INSTRUCTION PERIODS FOR OWNER'S PERSONNEL

- A. Scope: Following installation of mechanical work, have representatives of installation tradesmen conduct demonstrations and instruction periods to point out locations of servicing points and required points of maintenance to Owner's representatives.
- B. General Description of Instruction Periods: Each period shall include preliminary discussion and presentation of information from maintenance manuals with appropriate references to drawings, followed by tours of building areas explaining maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures, settings, and available adjustments.
- C. Scheduling of Instruction Periods: Notice of Contractor's readiness to conduct such instruction and demonstration shall be given to the Owner's representative at least two weeks prior to the instruction periods, and agreement reached as to the date at which the instruction periods are to be performed. Advise Owner's representative two weeks prior to date when ready to conduct instruction and demonstrations; receive approvals of proposed date prior to making final arrangements.

3.28 ON-SITE OBSERVATIONS AND SAFETY MEASURES

- A. During its progress, all work shall be subject to observation by the Owner's representative, and of the National Board of Fire Underwriters, State and Local Inspectors. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be totally responsible for conditions of the jobsite, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Owner's representative to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near

the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction" in the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the State and/or Federal Safety Inspector for interpretation whenever in doubt as to whether he is or is not in compliance with State and/or Federal regulations. Furthermore, the Contractor distinctly assumes all risk or damage or injury to any persons or property wherever located resulting from any action or operation under this contract or in connection with the work.

3.29 CONTINUITY OF BUILDING UTILITIES AND SHUTDOWNS

- A. General: Continuity of utilities services in the building shall be maintained at all times, as required to provide heat, water, lighting, and power to all portions of the building. Utility systems shutdowns required for extensions, alterations or connections of new services shall be accomplished in accordance with the following requirements.
- B. Shutdowns: While building is in operation, utilities shutdowns shall be scheduled for weekends, holidays, or at night, if the shutdown affects the use of the building or surrounding buildings. The actual time and date is to be coordinated with and approved by the Owner's representative at least 72 hours in advance.
- C. Costs: The Contractor shall include in his bid proposal all costs associated with utilities shutdowns. No extra payment will be made for overtime work, schedule changes, or failure to complete utilities connections within authorized shutdown periods.

END OF SECTION

SECTION 22 05 19

GAUGES AND METERS FOR PLUMBING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pressure Gauges
- B. Pressure Gauge Accessories
- C. Stem Type Thermometers
- D. Test Plugs

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Domestic Water Piping

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.

1.04 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.06 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 - PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:

1. H.O. Trerice Co.
 2. Weiss Instrument, Inc.
 3. Weksler Instrument Co.
 4. Approved equal
- B. Gauge: ASME B40.1, stainless steel case, phosphor bronze tube, rotary brass movement, brass socket, black scale on white background.
1. Case: Drawn stainless steel, with stainless steel ring.
 2. Window: Lexan or acrylic.
 3. Size: 4-1/2" diameter.
 4. Mid-Scale Accuracy: 1% middle half of range, 2% of full range.
 5. Scale: Psi.
 6. Range: Contractor to select operating pressure near middle of range. Provide combination scale for pump suction applications.

2.02 PRESSURE GAUGE ACCESSORIES

- A. Needle Valve: Brass, 1/4" NPT for minimum 150 psi. Usage: all projects.
- B. Pulsation Damper: Pressure snubber, brass with 1/4" connections. Usage: all projects.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
1. H.O. Trerice Co.
 2. Weiss Instrument, Inc.
 3. Weksler Instrument Co.
 4. Approved equal
- B. Thermometers - Fixed Mounting: Blue-appearing non-toxic liquid in glass; ASTM E 1; lens front tube, cast aluminum case with enamel finish.
1. Size: 9" scale.
 2. Case: Cast Aluminum, no plastic case.
 3. Window: Clear Lexan or acrylic.
 4. Fill Type: Blue colored, spirit, organic.
 5. Mercury fill is not acceptable.
 6. Stem: 3/4" NPT with 3-1/2" standard brass socket.
 7. Accuracy: 1%.
 8. Calibration: Degrees F.

2.04 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap for receiving 1/8" outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2" diameter pressure gauge, one gauge adapter, with 1/8" probes, two 1" dial thermometers. Provide one Test Kit for Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Extend nipples to allow clearance from insulation.
- C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- D. Provide instruments with scale ranges selected according to service with largest appropriate scale. Scale selected shall operate near center of range.
- E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- F. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- G. Locate test plugs where indicated on Plans. Also provide adjacent pressure gauges, thermometers even if not shown.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING, PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Valve Tags.
- C. Pipe Markers and Arrows.
- D. Equipment Identification Nameplates.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.
- B. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification, include matching size and colored arrows.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturer's catalog literature for each product required.
- D. Project Record Documents: Record actual locations of tagged valves, on As-Built's.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Brady Corporation

- B. Seton Identification Products
- C. Marking Services, Inc.
- D. Approved equal.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height, Equipment: 1-1/2"
 - 3. Background Color: Black.

2.03 VALVE TAGS

- A. Metal Tags: Brass with stamped blackened letters; tag size minimum 1-1/2" diameter with smooth edges, 40 mils thick.
- B. Tag Lettering: First Line = System Abbreviation; Second Line = Consecutive Valve Numbers, starting at 01.
- C. Beaded Chain: #6 x 4-1/2" - Nickel Plated.

2.04 PIPE MARKERS AND ARROWS

- A. Comply with ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Tape Pipe Arrows: Nominal sizes and colors to match pipe markers. 1", 2" and 4".
- D. Size of pipe markers:
 - 1. 3/4" to 1-1/4" OSD of covering = 1/2" letters.
 - 2. 1-1/2" to 2" OSD of covering = 3/4" letters.
 - 3. 2-1/2" to 6" OSD of covering = 1-1/4" letters.
 - 4. 8" to 10" OSD of covering = 2-1/2" letters.
 - 5. Over 10" OSD of covering = 3-1/2" letters.

2.05 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. Description:
 - 1. Plastic Laminate 1-1/4" letters and arrow.
 - 2. Vinyl Markers 1-1/4" letter and arrow.
 - 3. Color per ASME standards.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install plastic nameplates and markers with corrosion-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.
- B. Install tags with nickel-plated chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions. Install a circular wrap of arrows at each end of the pipe marker.
- D. Install plastic tape pipe arrows completely around pipe in accordance with manufacturer's instructions.
- E. Identify all mechanical equipment, air handling units, pumps, heat transfer equipment, tanks, water treatment devices, etc., with plastic nameplates.
- F. Identify control panels and major control components on outside of panels with plastic nameplates.
- G. Identify ALL valves with tags.
- H. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20' on center for straight runs including risers and drops, adjacent each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Glass Fiber Pipe Insulation, Rigid and Semi-Rigid
- B. Jackets

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- F. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

- K. All insulation material and installations shall meet or exceed Washington State Energy Code.
- L. All codes and standards shall be latest version as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials, thickness for each service, and locations.
- B. QUALITY ASSURANCE

1.05 PERFORM WORK IN ACCORDANCE WITH APPLICABLE CODES.

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

PART 2 - PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50 maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
- B. Provide thickness of insulation to meet or exceed Washington State Energy Code and/or local codes, whichever is more stringent.

2.02 MANUFACTURERS

- A. Knauf Fiberglass
- B. Johns Manville Corporation
- C. Owens Corning Corporation
- D. CertainTeed Corporation
- E. Pittsburgh Corning Corporation
- F. Armacell International

- G. Approved equal

2.03 GLASS FIBER

- A. Pipe Insulation: ASTM C 547 and ASTM C 795; rigid molded, noncombustible, with factory applied vapor barrier jacket.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum service temperature: 850 degrees F.
 3. Maximum moisture absorption: 0.2% by volume.
- B. Usage: Domestic Water, Condensate Piping - Interior - Medium to Low Temperature, bare tanks and uninsulated plumbing equipment.
- C. Vapor Barrier Jacket: White kraft paper, All Service Jacket (ASJ), with 2" overlapped joints, and glass-fiber yarn, bonded to aluminized film finished in white craft paper; moisture vapor transmission when tested in accordance with ASTM E 96/E 96M of 0.02 perm-inches.
- D. Tie Wire: 0.048" stainless steel with twisted ends on maximum 12" centers.
- E. Vapor Barrier Coating:
1. Manufacturers:
 - a. Childers Model CP-35
 - b. Approved equal.
 2. Compatible with insulation.
- F. Insulating Mastic/Coating:
1. Manufacturers:
 - a. Childers Model CP-10/11
 - b. Approved equal.
- G. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 ounces per square yard.
 2. Blanket: 1.0 pounds per cubic foot density.
 3. Weave: 5x5.
- H. Combination Coating and Lagging Adhesive:
1. Manufacturers:
 - a. Childers Model CP-50A HV2
 - b. Approved equal.
- I. Fibrous Adhesive:
1. Manufacturers:
 - a. Childers Model CP-97
 - b. Approved equal.

2.04 JACKETS

- A. PVC Plastic.

1. Jacket: One-piece molded-type fitting covers and sheet material; off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush-on welding adhesive.
 2. Covering Adhesive Mastic:
 3. Compatible with insulation.
- B. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
1. Thickness: 0.016".
 2. Finish: 3/16 corrugations.
 3. Fittings: 0.010" thick die shaped fitting covers with factory attached protective liner.
 4. Metal Jacket Bands: 3/8" wide; 0.010" thick stainless steel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards, have a copy on site for reference. Employ only skilled tradesmen specializing in this kind of work.
- C. Exposed Piping: Locate seams of insulation and cover in least visible locations.
- D. Insulated piping conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated piping conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding stainless steel staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent piping. Finish with PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment. Bevel and seal ends of insulation.

- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets with vapor barrier, factory-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding stainless steel staples. Maintain a continuous vapor barrier.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with PVC fitting covers.
- H. Inserts and Shields: Provided and installed by piping contractor at each hanger. Reference Section 22 00 20.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
- J. Insulate all domestic cold water, copper condensate piping, rain leaders and roof drain bowls with a minimum of 1/2" insulation or as required by the Washington State Energy Code and or local codes, whichever is more stringent.
- K. Piping Exposed less than 8' above finished floor: Finish with stainless steel jacket and stainless steel fitting covers.

3.03 SCHEDULES OF THICKNESSES

- A. Provide thicknesses of insulation to meet or exceed Washington State Energy Code and or local codes, whichever is more stringent.

END OF SECTION

SECTION 22 10 05

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Water Piping, Buried to 5' outside of Building
- B. Water Piping, Above Grade
- C. Flanges, Unions, and Couplings
- D. Pipe Hangers and Supports
- E. Ball Valves
- F. Butterfly Valves
- G. Flow Control Valves
- H. Thermostatic Balancing Valve
- I. Swing Check Valves
- J. Water Pressure Reducing Valves
- K. Relief Valves
- L. Strainers
- M. Drain Valves

1.02 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 22 07 19 - Plumbing Piping Insulation.
- C. Division 31 - Excavation, Fill, and Trenching.

1.03 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; (ANSI B16.18).

- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- C. ASME B16.51 Copper and Copper Press-Connect Pressure Fittings
- D. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; (ANSI/ASME B31.9).
- E. ASTM B32 - Standard Specification for Solder Metal.
- F. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
- G. ASTM B75 - Standard Specification for Seamless Copper Tube.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- I. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- J. ICC LC1002 PMG Listing Criteria for Press Connection Fittings for Potable Water Tube and Radiant Heating Systems
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- L. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- M. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- N. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- O. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- P. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- Q. NSF Standard 14: Plastic Piping Components & Related Materials
- R. NSF 61 & NSF 372 Drinking water system components and drinking water systems components – lead content.
- S. NSF 61-G Annex G Lead Free Designation

- T. All codes and standards shall be latest version as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide data on all materials, tubing, tube fittings, valves, and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings.
- B. Shop Drawings: Provide drawings covering all specially-designed hanger assemblies and fabrications. Also provide drawings showing assemblies of standard manufactured hangers based upon this particular project's requirements.
- C. Project Record Documents: Record actual locations of valves, buried piping, and any other changes made to contract drawings.
- D. Mechanical Contractor to submit sketches covering all hangers proposed for use on this project. Manufacturer's data shall also be submitted.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. All domestic water piping and valves in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards, or be NSF-61-G certified to all requirements of NSF/ANSI 61 (health effects) and all requirements of Annex G and NSF/ANSI 372 (lead content) via third-party testing and certification.
- D. Do not solder within 12" of valves manufactured from any bismuth alloy.
- E. CPVC piping: domestically produced rigid polyvinyl chloride (PVC) compound. Product marking shall meet the requirements of ASTM D1785 and ASTM D2665 as applicable and shall include: the manufacturer's name or trademark; the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM designation D1785; the ASTM designation D2665 (when dual marked); the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture. Marking shall also include the flame spread rating and smoke development rating when tested and listed for surface burning characteristics.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept products on site in shipping containers with labeling in place. Inspect for damage.

- B. Protect piping systems from entry of foreign materials by providing temporary covers, completing sections of the work, and isolating parts of completed system.
- C. Plastic Pipe
 - 1. Read the manufacturer's installation instructions.
 - 2. Keep pipe and fittings in original packaging until needed.
 - 3. Cover pipe and fittings with an opaque tarp if stored outdoors.
 - 4. Inspect pipe for damage prior to use.
 - 5. Use tools specifically designed for use with plastic pipe.

PART 2 - PRODUCTS

2.01 WATER PIPING, BURIED TO 5' OUTSIDE OF BUILDING

- A. Copper Tube: ASTM B42, hard drawn, type K.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.

2.02 WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Hard Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. ASTM B 32, lead-free solder.
 - b. Extracted collars approved for pipe sizes 1/2" to 2". For joints made with a T-Drill mechanical extractor, follow manufacturer's operating instructions.
 - c. Press-Seal Fitting, approved for pipe sizes 1/2" to 4".
 - 1) Manufacturers
 - a) Viega,
 - b) Nibco Press System
 - c) Approved equal
 - 2) Fittings shall be manufactured with an inboard bead design having compression crimp applied on both upstream and downstream sides of EPDM elastomeric seal bead and unpressed fitting leak identification feature. 2-1/2" thru 4" shall have a 420 stainless steel grip ring, PBT separator ring, and EPDM sealing element.
 - d. Mechanical Couplings: See paragraph "Flanges, Unions and Couplings"

2.03 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 2" and Under:
 - 1. Copper tube: Class 150 bronze unions with soldered joints.

- B. Flanges for Pipe Size 2-1/2" and larger.
 - 1. Copper tube: Class 150 slip-on bronze flanges; preformed EPDM gaskets.
- C. Mechanical Couplings for Grooved and Shouldered Joints
 - 1. Manufacturers:
 - a. Victaulic
 - b. Gruvlok
 - c. Approved equal
 - 2. Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 3. Grooved mechanical couplings. 200 psi minimum joint working pressure, cast ductile iron housing conforming with ASTM A-536. Gaskets for domestic water service, EPDM per ASTM D-2000.
 - 4. Grooved mechanical flange adapters shall be ductile iron (ASTM A-536), engaging directly into roll grooved copper tube and fittings and bolting directly into ANSI Class 150 steel flanged components. Gasket material similar to coupling gasket material noted above.
 - 5. Dimensions and Testing: In accordance with AWWA C606.
 - 6. Housing Material: Ductile iron conforming to ASTM A-536, grade 65-45-12.
 - 7. Housing Coating: Copper-colored alkyd enamel.
 - 8. Gasket Material: Grade EHP or EP, UL classified in accordance with ANSI/NSF 61 for cold +86°F/+30°C and hot +180°F/+82°C potable water service.
 - 9. Bolts and Nuts: Hot dipped galvanized.
 - 10. When pipe is field grooved, provide coupling manufacturer's grooving tools if required by manufacturer's warranty.
- D. Dielectric Connections
 - 1. Manufacturers:
 - a. Victaulic
 - b. Gruvlok
 - c. Approved equal
 - 2. Provide dielectric waterway fittings that maintain external electrical continuity while maintaining internal isolation. Fittings shall comply with ASTM F 492, and be listed by IAPMO. For pipe sizes 2" and less used dielectric nipples and for pipe sizes 2-1/2" and larger use dielectric flange kits. Do not use dielectric unions.

2.04 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with ASME B31.9, MSS SP-58 & SP-69.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 & SP-69 recommendations, see Section 22 00 20.

2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Supports for roof mounted pipe, for flat roof applications, see Section 22 00 20
- B. Plumbing Piping - Water:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2" to 2": Carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Water Piping Sizes 2" and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Water Piping Sizes 2" and over: Carbon steel, adjustable, clevis.
 5. Adjustable side beam clamps MSS-SP69-Type 25 or approved equal.
 6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Piping Sizes 6" and over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
 8. Vertical Support: Steel riser clamp.
 9. Floor Support for Cold Piping: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and or steel support.
 10. Floor Support for Hot Piping: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and steel support.
 11. Floor Support for Hot Piping Sizes 6" and Over: Adjustable cast iron pipe roll and stand, steel screws, and steel support.
 12. Copper Tube Support: Carbon steel ring, adjustable, copper plated.
 13. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded, zinc plated.
 14. All hanger materials to be zinc or cadmium plated.
 15. Isolate all pipe work within the first 50' of vibration isolated equipment or within the mechanical spaces, whichever is greater.
 16. Provide roller hangers for all applications where thermal movement causes hanger rods to deviate more than 4 degrees from vertical or longitudinal movement exceeds 1/2". Provide protection saddles for use with roller hanger.
 17. All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook and furnished by the Mechanical Contractor and shall have one coat of primer paint prior to or after installation.
 18. It shall be the responsibility of the Mechanical Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially-accepted pipe hangers and accessories.

2.05 VALVES

- A. Manufacturers:
1. Armstrong
 2. Apollo

3. Asco
 4. Griswold Controls
 5. Gruvlok
 6. Kitz
 7. Milwaukee Valve Company
 8. Nexus
 9. Nibco, Inc.
 10. Red-White Valve Corporation
 11. Stockham Valve Company
 12. ThermOmegaTech
 13. Tour Anderson
 14. Victaulic
 15. Viega, LLC
 16. Watts Regulator Company
 17. Zurn-Wilkins Industries
 18. Approved equal
- B. Ball Valves
1. 2" and Smaller:
 - a. MSS SP-110, 150 psig SWP, 600 psig CWP, bronze, two-piece body, chrome-plated brass ball, full port, teflon seats and stuffing box ring, blow-out-proof stem, lever handle, with solder, threaded, or grooved ends; provide stem extension to allow operation without interfering with pipe insulation.
- C. Butterfly Valves
1. 2-1/2" and Larger:
 - a. MSS SP-67, 200 psi CWP, ductile iron body, aluminum bronze disc, resilient replaceable EPDM seat, lug ends, extended neck, infinite position lever handle with memory stop.
 - b. Provide gear operators for valves 6" and larger.
 - c. Provide chain-wheel operators for valves 6" and larger mounted over 8' above floor.
 - d. Provide butterfly valve with gear operator for main building shut off.
- D. Flow Control Valves / Circuit Balance Valve
1. 3" and Smaller:
 - a. Class 125, Brass or bronze body with union on inlet , temperature and pressure test plugs on inlet and outlet .
 - b. To retain calibrated accuracy, a minimum length of unrestricted straight pipe adjacent the valve shall be 3 pipe diameters upstream, and 1 pipe diameter downstream.
- E. Swing Check Valves
1. Up to 2":
 - a. MSS SP-80, Class 150, bronze body and cap, bronze swing disc with bronze seat, solder or threaded ends.

- F. Water Pressure Reducing Valves
 - 1. Single Valves
 - a. Up to 2":
 - 1) Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends. Equal to Watts 223, lead free.
 - b. 2-1/2" and larger:
 - 1) Bronze body, stainless steel and elastomeric diaphragm and seat disc, flanged ends. Equal to Watts N223B, lead free.
- G. Relief Valves
 - 1. Temperature and Pressure Relief:
 - a. CSA certified to ANSI Z21.22, bronze body, teflon seat, stainless steel stem and springs, automatic, direct-pressure actuated. Temperature relief maximum 210 degrees F. Capacity ASME (BPV IV) certified and labeled.
- H. Solenoid Valves
 - 1. 2-1/2" and smaller; brass or stainless steel body, stainless steel internal components, 24vdc or 120vac operation, watertight or watertight/explosion-proof solenoid enclosure, CSA certified. Valves shall be line size and full port. Asco 8210 or approved equal.
- I. Strainers
 - 1. Size 2" and Under:
 - a. Threaded bronze body for 175 psi working pressure, Y-pattern with 1/32" stainless steel perforated screen. Equal to Watts 777. Provide lead-free models where in contact with potable water.
 - 2. Size 2-1/2" and Larger:
 - a. Class 125, flanged bronze or grooved ductile iron body, Y- pattern with 3/16" stainless steel perforated screen. Equal to Watts 77F-B. Provide lead-free models equal to Watts 77F-DI-FDA-125 where in contact with potable water.
- J. Drain Valves
 - 1. Provide a full-port ball valve with 3/4" hose connection, cap and chain at all low points and at equipment drains. Nibco T-585-70HC or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt; protect open ends with temporary plugs or caps.
- E. After completion, fill, clean and disinfect system.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Lead type solders are not allowed on the jobsite.
- C. Use only water soluble paste flux designed to work with lead free solders.
- D. Do not solder within 12" of valves, flanges, etc., manufactured from any bismuth alloy.
- E. Provide non-conducting dielectric waterway connections wherever jointing dissimilar metals. Dielectric unions are not allowed.
- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain 6'-8" headroom minimum, conserve space, and do not interfere with use of the space.
- H. Group piping whenever practical at common elevations.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- K. Provide access where valves and fittings are not exposed, minimum size 12" x 12".
- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide circuit balance and check valves between domestic hot water and hot water circulating branch lines on the return leg, even if not shown on the Plans. All branches are to be balanced.
- N. Install water piping to ASME B31.9.
- O. Copper Tube Extracted Joints may be used on copper tubing. Dimple branch connection to control insertion. Brazed joints only.

- P. Tube Press Fit Joints shall be installed in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked after pressing against the mark on the tubing to assure the tubing is fully inserted into the fitting. The joints shall be pressed using only the tool approved by the manufacturer.
- Q. Copper Tube Rolled Groove joints shall be installed in accordance with manufacturer's instructions.
- R. Provide sleeves for pipes passing through partitions, walls and floors. Use commercially manufactured modular seals for sleeves passing through floors, below-grade walls and floor slabs below grade. Make these penetrations water-tight against ground water pressure.
- S. Pipe Hangers and Supports:
 - 1. It shall be the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard commercially-accepted pipe hangers and accessories.
 - 2. Install in accordance with ASME B31.9 and MSS SP-89.
 - 3. Use only adjustable side beam clamps (Type 25); standard beam clamps are not acceptable.
 - 4. Inserts and shields are to be placed at each hanger by the piping contractor. Reference Section 22 00 20.
 - 5. Install hangers to provide a minimum of 1/2" space between finished covering and adjacent work.
 - 6. Place hangers within 12" of each horizontal elbow.
 - 7. Use hangers with 1-1/2" minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 8. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 9. Where more than one piping run can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 10. Provide copper-plated hangers and supports for un-insulated copper tubing. Pipe-tight hangers are acceptable only for piping conveying fluids at ambient temperatures. All Hot Water, Hot Water Circulating, Cold Water, Heating Water, Condensing Water, and Chilled Water piping, etc., is to be insulated.
 - 11. Provide hangers adjacent motor-driven equipment with vibration isolation.
 - 12. Auxiliary Steel: All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook, and shall be furnished and installed by this Contractor.
 - 13. All steel rods, hangers and brackets, shall be electro-plated. Custom fabricated steel brackets or hangers shall receive one shop coat primer paint by this Contractor.

3.03 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.

- B. Provide unions downstream of valves and at equipment or apparatus connections.
- C. Provide ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.
- D. Provide flow controls in water recirculating systems where required or indicated.
- E. Provide isolation valves with positive shutoff for domestic hot water, cold water and hot water recirculation at restrooms. Isolation valves shall be located above T-bar ceiling in area adjacent restrooms where possible. If located above a hard ceiling, provide access panel.
- F. Connect hot water circulating piping to hot water piping within 24" of plumbing fixtures. Bring circulating piping down into wall as needed to meet this distance requirement.

3.04 TOLERANCES

- A. Water Piping: Slope at minimum of 1/32" per foot, and arrange to drain at low points.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Inject disinfectant (free chlorine in liquid, powder, tablet or gas form) throughout system to obtain 50 to 80 mg/L residual.
- C. Bleed water from outlets to ensure distribution, and test for disinfectant residual at minimum of 15% of outlets.
- D. Leave disinfectant in system for 24 hours.
- E. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- F. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.
- G. Take samples no sooner than 24 hours after flushing, from 10% of outlets and from water point of entry; analyze in accordance with AWWA C651.
- H. Provide copies of certified test reports from the Health Department to the Owner's Commissioning Agent, Owner's representative, and General Contractor prior to occupancy.

3.06 SERVICE CONNECTIONS

- A. Provide new water service complete with the following components in a Water Header as detailed on the contract drawings.

1. Approved reduced pressure backflow preventer (RPBP); do not install bypass or add drains or vents upstream of the RPBP.
2. Pressure reducing valve (PRV) with bypass and globe valve.
3. Y-Strainer, to share bypass with PRV. Pipe strainer blow-off to nearest drain; provide full-port ball valve on drain.
4. System-rated water hammer arrestors: Provide PPP SCS Series 150-pound flanged, 2" minimum size.
5. Drain valves: Provide at low point on header.
6. Pressure Gauges. Provide two minimum, located on each side of PRV.
7. Provide sleeves in walls or floors for service mains. Make watertight with commercially-manufactured modular seals and pliable material. Anchor service main inside of building to concrete walls or floors.
8. Provide Schedule 40 galvanized pipe sleeve around service main to 1" above finished floor.
9. See detail on Plans.

3.07 TESTING

- A. Test Domestic Water a minimum of 100 PSI or 1-1/2 times incoming pressure whichever is greater and hold pressure for two hours, without loss of pressure. Have the test witnessed by the Owner's representative. If the building is phased, provide multiple tests as needed.

END OF SECTION

SECTION 22 10 06

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Non-Freeze Wall Box Hydrants
- B. Refrigerator Recessed Box
- C. Reduced Pressure Backflow Preventer
- D. Water Hammer Arrestors
- E. Trap Primers
- F. Thermostatic Mixing Valves

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Domestic Water Piping.
- B. Section 22 40 00 - Plumbing Fixtures.
- C. Section 22 30 00 - Plumbing Equipment.

1.03 REFERENCE STANDARDS

- A. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering; 2004 (ANSI/ASSE 1011).
- B. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering.
- C. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering; (ANSI/ASSE 1019).
- D. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute.
- E. All codes and standards shall be latest version as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Instructions: Indicate manufacturer's installation instructions: Indicate assembly and support requirements.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Products specified in this section shall be manufactured in the United States of America. Products shall be labeled with the manufacturer's logo and country of origin. This paragraph will be strictly enforced; contractors to bid this project accordingly.
- C. All Domestic Water Piping Specialties in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards, or be NSF-61-G certified to all requirements of NSF/ANSI 61 (health effects) and all requirements of Annex G and NSF/ANSI 372 (lead content) via third-party testing and certification.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on-site in original factory packaging. Inspect for damage.

1.07 EXTRA MATERIALS

- A. Supply for Owner's use in maintenance of project:
 - 1. One extra loose key for each inside and outside hose bibb and/or hydrants.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for installation of backflow preventing devices.
- B. Provide certificate from Authority Having Jurisdiction indicating approval of installation of backflow preventing devices.

PART 2 - PRODUCTS

2.01 NON-FREEZE HYDRANTS

- A. Manufacturers:

1. Jay R. Smith Manufacturing Company
 2. Woodford Industries
 3. Zurn
 4. Approved equal
- B. Wall Hydrant, Single Temperature, ASSE 1052
1. Box-type, integral vacuum breaker, nickel-plated bronze, quarter-turn, with wall clamp and T-handle key.
 - a. Jay R. Smith 5509QT or approved equal.

2.02 REFRIGERATOR ICE-MAKER OUTLET BOX

- A. Box Manufacturers:
1. IPS Corporation/Guy Gray
 2. Oatey
 3. Sioux Chief
 4. Approved equal
- B. Epoxy-coated steel rough-in box, lead-free valve, hammer arrester; Guy Gray IMOB, or approved equal.
- C. Fire-rated box: Epoxy-coated steel rough-in box, brass valves, water hammer arresters, and intumescent pads; Guy Gray FR-12 or approved equal

2.03 REDUCED PRESSURE BACKFLOW PREVENTERS

- A. Manufacturers:
1. Watts Regulator Company
 2. Zurn/Wilkins Industries, Inc.
 3. Approved equal
- B. All reduced pressure backflow preventers shall be listed by the State of Washington Department of Health as an approved cross-connection control device.
- C. Provide air-gap fitting and route drainage piping to nearest floor drain.
- D. Reduced-Pressure Backflow Preventers
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating spring-loaded check valves, diaphragm-type differential pressure relief valve located between check valves, third check valve that opens under backpressure in case of diaphragm failure, non-threaded vent outlet, assembled with two ball valves (gear-operated butterfly valves on 2-1/2" and larger), and four test cocks.
 - a. Watts 957QT - Silver Eagle or approved equal.
 2. Gate valves to be bronze, or substituted with butterfly valves.
- E. Reduced Pressure Zone Assembly

1. A Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to back-siphonage and/ or back-pressure.
2. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. Body and shutoffs shall be constructed using Lead Free* cast copper silicon alloy materials. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks, and an air gap drain fitting.
3. Lead Free* reduced pressure zone assembly shall comply with state codes and standards requiring reduced lead content. The assembly shall meet the requirements of: USC; ASSE Standard 1013 and AWWA Standard C511; CSA B64.4.
 - a. Watts Series LF009 or approved equal.

2.04 WATER HAMMER ARRESTORS

- A. Manufacturers:
 1. Jay R. Smith Manufacturing Company
 2. Precision Plumbing Products
 3. Zurn Industries, Inc.
 4. Approved equal
- B. Water Hammer Arrestors:
 1. Stainless steel construction, bellows-type, sized in accordance with PDI-WH 201.
 2. Precharged, suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.05 TRAP PRIMERS

- A. Manufacturers:
 1. Precision Plumbing Products, Inc.
 2. Jay R Smith
 3. Approved equal
- B. General
 1. Provide ball valve shut-off at each trap primer.
 2. Provide an access panel large enough to remove and replace trap primer assembly; panel minimum size is 12" x 12".
- C. Provide non-electronic trap primers for all traps where electronic trap primers have not been provided on plans.

- D. Electronic Trap Primer for one to four drains: Provide a PPP MPB-500 Mini-Primer with distribution unit, 120v, with electronic controller, 1/2" inlet, integral vacuum breaker and flush mount cabinet with prime coat or stainless steel access door as needed.
- E. Electronic Trap Primer for four to thirty drains: Provide a PPP PT-*, Prime Time, 120v, with 24 hour clock, 3/4" inlet. integral vacuum breaker and flush mount cabinet with prime coated, stainless steel, or fire rated prime coated access door, as needed. * in model number indicates number of manifold openings.

2.06 THERMOSTATIC MIXING VALVES

- A. Manufacturers:
 - 1. Powers
 - 2. Leonard Valve Company
 - 3. Bradley
 - 4. Lawler
 - 5. Approved equal
- B. Thermostatic Mixing Valves:
 - 1. Valve: Cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment. Valve to have cold water bypass in case of valve failure or loss of hot water. Valve to be Certified lead free. ASSE 1017.
 - 2. Capacity: See schedule.
 - 3. Accessories:
 - a. Stem thermometer on outlet.
 - b. Strainer stop checks on inlets.
 - 4. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.
- C. Individual Lavatory Mixing Valve
 - 1. ASSE 1016, bronze body with corrosion-resistant internal parts, 1/2" NPT. Includes integral checks with screens and thermal actuator to compensate for inlet temperature fluctuations. Valve to be factory set at 105 degrees F. Install under individual lavatories to mix and adjust hot water temperature. Each tempering valve shall serve an individual lavatory or sink. Valve to be Certified Lead Free.
 - 2. Piping connections are to be made so as to permit proper operation of integral check valves.
 - 3. Equal to Powers LFe480.

PART 3 - EXECUTION

3.01 INSTALLATION

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

- B. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur, as required or as shown on the Plans.
- C. Pipe drain from reduced pressure backflow preventer to nearest drain, utilizing an air gap fitting.
- D. Provide individual mixing valves under the counter for all lavatories.
- E. The Mechanical Contractor shall be responsible for providing trap primers, water to trap primers and running primer lines to the drains. Trap primer layout shall be by contractor. Verify location of trap primers with Owner's representative before installing. ALL floor drains and floor sinks, are to have primers. Show trap primer locations on Record Drawings.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, washing machine outlets, etc. for fixtures equipped with quick-closing valves. Install on cold water supply for any fixtures with flush valves. Install behind access panel for future maintenance; minimum panel size 12" x 12".
- G. Provide access panels for all concealed valves in walls or above hard ceiling.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE, VENT, AND STORM PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, and connections for piping systems
- B. Sanitary Sewer Piping, Buried to 5' Outside of Building
- C. Sanitary Sewer piping, Above Grade
- D. Flanges, Unions, and Couplings
- E. Pipe Hangers and Supports

1.02 RELATED SECTIONS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 22 07 19 - Plumbing Piping Insulation.
- C. Division 31 - Excavation, Fill, Trenching.

1.03 REFERENCES

- A. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; (ANSI/ASME B31.9).
- B. ASTM A 74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- C. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- D. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- E. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute.
- F. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute.

- G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- H. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- I. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- J. d by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalog information. Indicate valve data and ratings.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Accept products on-site in shipping containers with labeling in place. Inspect for damage.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. AB&I
- B. Charlotte
- C. Tyler
- D. Approved equal

2.02 SANITARY SEWER PIPING, BURIED TO 5' OUTSIDE OF BUILDING

- A. Cast Iron Pipe: CISPI 301 and ASTM A888, hubless.
 - 1. Fittings: Iron.
 - 2. Joints: Heavy-duty shielded, stainless steel couplings, with stainless steel shield, stainless steel bands and tightening devices and ASTM C56A rubber sleeve.
 - a. Manufacturers

- 1) Clamp-All Hi -Torq 125
 - 2) Husky SD 4000
 - 3) Approved equal; must be listed for underground application.
3. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301 and ASTM A888, hubless.
 1. Fittings: Iron.
 2. Joints: CISPI 310, neoprene gasket or stainless steel clamp and shield assemblies conforming to ASTM C1277.
 - a. Manufacturers
 - 1) Clamp-All Hi-Torq 125
 - 2) Husky SD 4000
 - 3) Or Approved Equal.
 3. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute, and be listed by NSF International.

2.04 PIPE HANGERS AND SUPPORTS

- A. Plumbing Piping - Drain, Waste, and Vent:
 1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2" to 1-1/2": Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 4. Adjustable side beam clamps MSS-SP69-Type 25 or approved equal.
 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 6. Vertical Support: Steel riser clamp.
 7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Keep open ends of pipe free from scale and dirt, protect open ends with temporary plugs or caps.
- D. After completion, fill, clean and flush system.

3.02 INSTALLATION

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

- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain 6'-8" minimum headroom, conserve space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, or joints.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- G. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; All pipe shall be flashed, flashing shall extend to at least 10" in all directions from pipe and run at least 12" above roof around pipe. Each pipe shall be counter-flashed or turned down inside of pipe. Vent flashing shall be made watertight. Two-piece flashings are not acceptable.
- H. Pipe Hangers and Supports:
 - 1. It shall be the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard commercially-accepted pipe hangers and accessories.
 - 2. Use only adjustable side beam clamps (Type 25), standard beam clamps are not acceptable.
 - 3. Install hangers to provide a minimum of 1/2" space between finished covering and adjacent work.
 - 4. Place hangers within 12" of each horizontal elbow.
 - 5. Use hangers with 1-1/2" minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide hangers adjacent to motor driven equipment with vibration isolation.
 - 9. Support cast iron drainage piping at every joint.
 - 10. Auxiliary Steel: All auxiliary steel necessary for the installation of the pipe hangers and supports shall be designed in accordance with the AISC Steel Handbook, and furnished and installed by this Contractor.
 - 11. All steel rods, hangers and brackets, shall be electro-plated. Custom-fabricated steel brackets or hangers shall receive one shop coat of primer paint by this Contractor.
- I. Indirect drain piping shall terminate two (2) pipe diameters above the flood rim of the receptor and shall be cut at a 45 degree angle.

3.03 ERECTION TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2" vertically of location indicated and slope to drain at minimum of 1/4" per foot slope.

3.04 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide sleeves in walls or floors for service mains. Caulk enlarged sleeve and make watertight with modular seals and pliable material. Anchor service main inside to concrete walls or floors.
- C. Sleeves around service mains to be Schedule 40 galvanized pipe to 1" above finished floor.
- D. Backflow Protection: Fixtures installed on a floor level that is lower than the next upstream manhole cover of the public or private sewer shall be protected from backflow of sewage by installing an approved type of backwater valve. Fixtures on such floor level that are not below the next upstream manhole cover shall not be required to be protected by a backwater valve. Fixtures on floor levels above such elevation shall not discharge through the backwater valve. Cleanouts for drains that pass through a backwater valve shall be clearly identified with a permanent label stating "Backwater Valve Downstream".

3.05 TESTING

- A. Test the Drainage Systems as required by local Authority Having Jurisdiction.

END OF SECTION

SECTION 22 13 19

SANITARY & STORM PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Floor Drains
- B. Cleanouts
- C. Vandal-Proof Hooded Vent Caps

1.02 RELATED SECTIONS

- A. Section 22 10 05 - Plumbing Piping.
- B. Section 22 40 00 - Plumbing Fixtures.
- C. Section 22 30 00 - Plumbing Equipment.
- D. Division 31 - Excavation, Fill, and Trenching.

1.03 REFERENCES

- A. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- C. Operation Data: Indicate frequency of treatment required for interceptors.
- D. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

- B. Light commercial drains and cleanouts are not acceptable. If found on this project they will be removed and replaced by the Mechanical Contractor, at no cost to the Owner.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Wade, Inc.
 - 3. Zurn Industries, Inc.
 - 4. Josam
 - 5. Mifab
 - 6. Sioux Chief
 - 7. Approved equal.
- B. Floor Drain (FD):
 - 1. ASME A112.6.3; galvanized cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, trap primer connection, vandal-proof screws, and round, adjustable nickel-bronze strainer.
- C. Floor Sink (FS):
 - 1. Galvanized cast iron body with acid-resistant interior, seepage flange, flashing clamp, aluminum dome strainer, and vandal-proof screws. Size 8" x 8" x 6" deep. Equal to Jay R Smith 3100.
 - 2. Grate:
 - a. Nickel Bronze Rim, 1/2 Grate

2.02 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Zurn Industries, Inc.
 - 3. Wade, Inc.
 - 4. Mifab
 - 5. Josam
 - 6. Sioux Chief
 - 7. Approved equal.
- B. Cleanouts at Exterior Surfaced Areas (SCO):
 - 1. Round cast nickel bronze access frame and non-skid cover, marked "CO".

- C. Cleanouts at Exterior Unsurfaced Areas (SCO):
 - 1. Same as above except with 18" x 18" x 4" concrete pad around cleanout.
- D. Cleanouts at Interior Finished Floor Areas (FCO):
 - 1. Lacquered cast iron body with anchor flange, threaded top assembly, and round scoriated secured nickel bronze cover in a round depressed frame, with ABS tapered threaded plug.
 - 2. Cleanouts at Interior Finished Floor Areas for Carpeted Floors:
 - a. Where cleanout is installed in carpeted areas, provide nickel bronze carpet clamp frame.
 - b. MC to coordinate carpet clamp rings or correct after carpet installation.
 - 3. Cleanouts at Interior Finished Floor Areas for Tile Floors:
 - a. Where cleanout is installed in tiled areas, provide nickel bronze top with 1/8" tile recess cover; obtain tile piece to insert into cover.
- E. Cleanouts at Interior Finished Wall Areas (WCO):
 - 1. Line type with lacquered cast iron body and ABS tapered thread plug, and round smooth stainless steel access cover secured with stainless steel machine screws.
- F. Cleanouts at Interior Unfinished Accessible Areas (CO): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.
- G. Provide cleanouts at each pair of 45-degree elbows. At each 90-degree turn, and at each 50' of straight run.
- H. Cleanouts shall be line size up to and including 3" piping, and 4" for piping 4" and larger.

2.03 VANDAL-PROOF HOODED VENT CAPS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Zurn Industries, Inc.
 - 3. Wade, Inc.
 - 4. Josam
 - 5. Mifab
 - 6. Approved equal.
- B. Provide vandal proof vent caps on all vents passing through the roof. Vent caps to be lacquered cast iron body and dome. All units to be secured with fasteners internal to the units. Vent caps do not need flashing sleeves unless roofing membrane extends up vent.

PART 3 - EXECUTION

3.01 INSTALLATION

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

- B. MC to coordinate the height of floor drains with the GC.
- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- D. Ensure adequate clearance at Floor Cleanouts and Floor Drains for rodding of drainage system; 18" minimum required. Do not install Floor Cleanouts or Floor Drains directly under toilet partitions.
- E. Encase exterior cleanouts in concrete flush with grade.
- F. Install floor cleanouts at elevation to accommodate finished floor. Mechanical Contractor to coordinate with floor finisher for a smooth finished floor.
- G. Provide traps and trap primers for all drains (floor drains, floor sinks, etc.)
- H. Provide two-way cleanout at junction of building drain and building exterior sewer. Provide concrete pad around cleanout; see contract drawing details.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Residential Electric Water Heater
- B. Water Heater Drain Pan
- C. Diaphragm-Type Compression Tank
- D. In-Line Circulator Pump

1.02 RELATED REQUIREMENTS

- A. Division 31 - Excavation, Trenching, Fill

1.03 REFERENCE STANDARDS

- A. ASME CODE (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.
- B. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc.
- C. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- B. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tapings, and performance data.

- 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- C. Manufacturer's Installation Instructions.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- C. All Domestic Water Piping Equipment in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards, or be NSF-61-G certified to all requirements of NSF/ANSI 61 (health effects) and all requirements of Annex G and NSF/ANSI 372 (lead content) via third-party testing and certification.
- D. Provide Thermostatic Mixing Valves at each water heater or as shown on Plans. Reference Section 22 10 06. See detail on Plans.

1.06 CERTIFICATIONS

- A. All water heaters shall meet the requirements of the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 90.1-1999 and be so labeled. Controls shall not allow water temperature to exceed 210 degrees F. Water heaters shall comply with all provisions of the Washington State Energy Code.
- B. Water Heaters and Domestic Water Expansion Tanks shall be NSF approved.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. Provide five (5) year manufacturer warranty for domestic water heaters.

PART 2 - PRODUCTS

2.01 WATER HEATER MANUFACTURERS

- A. A.O. Smith Water Products Co
- B. State Water Heaters
- C. Bradford White
- D. Approved equal

2.02 RESIDENTIAL ELECTRIC WATER HEATERS

- A. Type: Automatic, electric, vertical storage.
- B. Performance: See Schedule on Plans.
- C. Tank:
 - 1. Glass lined welded steel,
 - 2. Meets thermal efficiency and standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1.
 - 3. Comply with the Federal Energy Conservation Standards effective April 16, 2015, in accordance with the Energy Policy and Conservation Act (EPCA).
 - 4. Encased in corrosion-resistant steel jacket with baked-on enamel finish.
 - 5. Meets UBC, CEC and HUD National Codes.
- D. Corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Automatic water thermostat with externally adjustable temperature range from 120 to 170 degrees F, flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.
- F. Provide with the following accessories:
 - 1. Heat Traps
 - 2. Water Connections: Brass.
 - 3. Dip tube: Brass.
 - 4. Drain Valve.
 - 5. Anode: Magnesium
 - 6. Temperature and Pressure Relief Valve: ASME-rated.

2.03 WATER HEATER DRAIN PAN

- A. Provide drain pan under all water heaters, constructed of plastic or aluminum. Pan to be 2" larger minimum each direction than the tank, 2.5" deep with top edge hemmed over for safety and strength.

- B. Provide a pan drain connection, located as close to the bottom of the pan as possible. Provide sloped drain piping to nearest floor drain, floor sink, or as shown on Plans.

2.04 DIAPHRAGM-TYPE DOMESTIC WATER COMPRESSION/EXPANSION TANK

- A. Manufacturers:
 - 1. Amtrol Inc.
 - 2. Armstrong
 - 3. ITT Bell & Gossett
 - 4. Taco, Inc.
 - 5. Approved equal.
- B. Construction: Welded steel, rated for working pressure of 150 psig, with flexible EPDM or butyl rubber diaphragm sealed into tank, and steel legs or saddles. Tank shall be suitable for Potable Water Systems.
- C. The tank shall be constructed, tested and stamped in accordance with Section VII, Division 1 of the ASME Code. All welds to conform to ASME Section IX.
- D. The water connection shall be 304L Stainless Steel with a circulation device inserted to encourage reduction of stagnant water within the tank water chamber.
- E. The internal water chamber shall include a molded polypropylene liner with a silver-ion based antimicrobial compound; tested to Standard JIS Z 2801 for efficacy in the reduction of Legionella (L. pneumophila). Staphylococcus (S. aureus) and Coliform (E. coli) bacteria on its surface
- F. Tanks shall carry NSF Standard 61 and IAPMO Lead-Free listings.
- G. Accessories: Pressure gage and air-charging fitting, tank drain.
- H. Precharge to 50 psig.
- I. Thermal expansion tank size shall be as shown on Schedule on Plans.

2.05 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. ITT Bell & Gossett
 - 3. Grundfos
 - 4. Taco, Inc.
 - 5. Approved equal.
- B. Construction
 - 1. Pump Body: Certified Lead-Free Bronze or stainless steel
 - 2. Impeller: Poly-phenylene Sulfide or Bronze
 - 3. Shaft: AISI 420 Stainless Steel

4. Bearing: Carbon Sleeve
 5. Gasket/O-Ring: EPDM
 6. All Other Wetted Parts: AISI 304 Stainless Steel
 7. Motor Type: Electronically Commutated Motor
 8. Motor Insulation Class: F
- C. Standard control modes
1. Proportional pressure control
 2. Constant pressure control
 3. Manual set constant speed.
 4. Night mode
 5. Set Point Temperature control
 6. Advanced settings can be managed from a PC, tablet or smartphone, and are accessible via optional built-in Wi-Fi or Ethernet cable.
 7. Multiple inputs including start-stop, temperature control, pressure regulation and advanced Modbus or BACnet control provide dynamic system management.
 8. An external temperature probe can be added for more advanced Delta T control.
- D. Performance: See Schedule on Plans.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. A separate switch shall be provided to permit turning off the energy supplied to electric service water heating systems.
- B. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- C. Domestic Water Storage Tanks:
1. Provide steel pipe support, independent of building structural framing members.
 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- D. Anchor and/or strap water heaters to resist displacement due to earthquake motion. Contractor to determine extent of bracing required, based on actual location and adjoining equipment and/or piping.

3.02 SYSTEM STARTUP

- A. Provide the services of a manufacturer's field representative for starting and testing equipment.

- B. Prepare a manufacturer's startup report and submit to the Owner's Representative.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Plumbing Fixtures.
- B. Fixture Carriers.
- C. Faucets and Trim.
- D. Emergency Fixtures.
- E. Water Efficiency Standards

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Domestic Water Piping.
- B. Section 22 10 06 - Domestic Water Piping Specialties
- C. Section 22 13 16 - Sanitary Waste, Vent Piping, and Storm Piping
- D. Section 22 13 19 - Sanitary and Storm Piping Specialties
- E. Section 22 30 00 - Plumbing Equipment

1.03 REFERENCE STANDARDS

- A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment.
- B. ASHRAE Standard 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.
- C. ARI 1010 - Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers; Air-Conditioning and Refrigeration Institute.
- D. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers.
- E. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical

Engineers.

- F. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers.
- G. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers.
- H. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers.
- I. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; The American Society of Mechanical Engineers.
- J. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals; The American Society of Mechanical Engineers.
- K. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Instructions: Indicate installation methods and procedures.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. All Plumbing Fixtures in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards, or be NSF-61-G certified to all requirements of NSF/ANSI 61 (health effects) and all requirements of Annex G and NSF/ANSI 372 (lead content) via third-party testing and certification.

1.06 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURES

- A. Manufacturers: The following manufacturers' products are approved. Select products and provide submittals to suit specific requirements of Specifications and Plans.
1. American Standard
 2. Beneke
 3. Bemis
 4. Brasscraft
 5. Brocar Products, Inc.
 6. Chicago Faucets
 7. Eljer
 8. Elkay
 9. Fiat
 10. Guy Gray/IPS
 11. Halsey Taylor
 12. Haws
 13. Jay R. Smith
 14. Josam
 15. Just
 16. Kohler
 17. McGuire
 18. Olsonite
 19. Precision Plumbing Products
 20. Sloan
 21. T&S Brass
 22. Truebro, Inc.
 23. Wade
 24. Watts
 25. Zurn
 26. Approved equal
- B. Fixtures are specified in the plumbing fixture schedule, followed by the catalog designation of the listed manufacturers. Similar fixtures of equal quality and type from manufacturers listed above are acceptable alternates subject to final approval.
- C. Fixtures shall be new, free from flaws and blemishes with bright, smooth surface. All vitreous ware shall be non-absorbent, even color, unwrapped, two-fired china. Enameled ironware shall be acid resisting porcelain enameled cast-iron.
- D. Flush valves shall be Sloan Royal models as listed in the fixture schedule. Similar flush valves of equal quality and type manufactured by Delaney or Zurn are acceptable alternates
- E. Water closet seats shall be open front, less cover, with concealed stainless steel,

self-sustaining check hinge and shall be sized to fit bowl size of water closet specified.

- F. Fixtures shall be white unless noted otherwise.
- G. All handicapped-accessible plumbing fixtures shall comply with the American With Disabilities Act (ADA) standards and procedures latest effective date. This Contractor shall verify these requirements with each manufacturer specified or acceptable alternate prior to the submittal process. All handicapped lavatories and sinks shall be provided with offset-type tailpieces.
- H. Handicapped-accessible sinks shall meet the size requirement below and shall comply with the American With Disabilities Act (ADA) standards and procedures latest effective date. The depth of the sinks shall be no more than 6-1/2", the front to back shall be no more than 19-1/2", the left to right dimension may vary. See the Plumbing Fixture Schedule on the drawings. If the scheduled sink is greater than the dimensions listed above, the MC shall coordinate the larger sink sizes with the Owner's representative and GC prior to ordering.
- I. All Plumbing Fixtures in contact with potable water shall be certified lead free (less than 1/4 of 1%). Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.
- J. Flush control for manual handicapped water closets shall be mounted for use from wide side of the water closet area.
- K. P-traps: P-traps shall be chrome-plated cast brass body with cleanout, 17 gauge seamless tubular wall bend with cast brass slip nuts. Trap shall be certified by CSA or other recognized testing authority. P-trap shall bear manufacturer and testing mark. P-traps shall be McGuire, Eastman, or approved equal.
- L. Plumbing Fixture Schedule: See Schedule on Plans.

2.02 FIXTURE CARRIERS

- A. Manufacturers
 - 1. Jay R. Smith
 - 2. Josam
 - 3. Mifab
 - 4. Wade
 - 5. Watts
 - 6. Zurn
 - 7. Approved equal
- B. Provide carrier types noted for the plumbing fixtures listed. Check and verify plumbing chase requirements with Plans. Provide back-to-back carriers where back-to-back fixtures are shown. Where floor mount carriers are called for,

anchor foot assembly to floor per manufacturer's written instructions. Floor-mounted single water closet carriers shall be back-bolted to the floor with two bolts via factory-provided bracket. Loose carriers will require re-working at the Mechanical Contractor's expense.

1. Lavatories: Floor mounted with concealed arm carriers or exposed arm carriers, see schedule.

2.03 FAUCETS AND TRIM

- A. Manufacturers
 1. Elkay
 2. Delta
 3. Chicago Faucets
 4. T&S Brass
 5. McGuire
 6. Brasscraft
 7. Approved equal
- B. Faucets and other trim shall be as listed in the Plumbing Fixture Schedule. Similar faucets and other trim of equal quality and type from manufacturers listed above are acceptable alternates subject to final approval..
- C. Provide all plumbing fixtures complete with all fittings, stops, risers, accessories, connections to waste, hot and cold water and /or flush connection as required to make each individual "P" unit pursuant to Plans a completely finished and working plumbing fixture. On retrofit projects, the water stops shall be replaced with new.
- D. All trim and exposed piping shall be chrome-plated brass. Supplies, wastes and traps in cabinets or under counters shall be considered exposed to view.
- E. All faucets shall have ADA-acceptable handles, even if the fixtures are not designated as ADA.
- F. Piping for flush valves shall be anchored to prevent movement in the wall. Products such as Holdrite 114-C shall be acceptable for use with water closets.
- G. Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.
- H. Provide insulation on exposed hot water supply, cold water supply and waste piping to ADA lavatory and ADA sink fixtures. Provide ADA pipe wrap for hot/cold/hot water recirculation/waste piping, on all exposed piping below any (ADA and non-ADA) lavatories and sinks.
 1. Manufacturers
 - a. Brocar Products, Inc.- Trap Wrap
 - b. Truebro, Inc. - Handi-Lav-Guard
 - c. McGuire - ProWrap
 - d. Zurn ADA Products

- e. Approved equal.

2.04 EMERGENCY FIXTURES

- A. Manufacturers:
 - 1. Haws Corporation
 - 2. Guardian Equipment
 - 3. Speakman
 - 4. Bradley
 - 5. Acorn
 - 6. Stingray Systems
 - 7. Approved equal
- B. Fixtures are specified in the plumbing fixture schedule followed by the catalog designation of the listed manufacturers. Similar fixtures of equal quality and type from manufacturers listed above are acceptable alternates subject to final approval.
- C. Provide all emergency fixtures with testing tag, and identification sign.
- D. Emergency Eye And Face Wash - Wall Mounted
 - 1. Comply with ANSI Z358.1
 - 2. Wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray, stainless steel dust cover, copper alloy control valve and fittings.
 - 3. Provide emergency eye and face wash with integrated mixing valve. Temperature adjustment is to be vandal-resistant.
- E. WATER EFFICIENCY STANDARDS
 - 1. All plumbing fixture water usage flow rates shall be in full compliance with the latest Washington State amendments to the Uniform Plumbing Code and/or requirements of local jurisdictions, whichever is more restrictive. Where more restrictive flows are shown on the Plumbing Fixture Schedule, these requirements shall take precedence.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that wall and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.
- B. Handicapped Mounting Heights:
- C. Water Closets: Mounting height from floor to top of seat shall be a maximum of 19" and a minimum of 17".
- D. Urinals: Front lip of basin shall not exceed 17" above finished floor.
- E. Lavatories: Lavatory rim or counter surface shall not be higher than 34" above the finished floor.
- F. Mechanical Contractor to coordinate mounting heights with the Architectural Drawings and applicable codes for both ADA and standard fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or braided stainless steel flexible supplies to fixtures with loose key stops, quarter-turn ball valves, reducers, and escutcheons. Where chrome-plated pipe and fittings are not available, typically commercial-type kitchen equipment installation, paint the pipe and fittings with chrome paint or provide stainless steel drain pipe and fittings.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant adhesive caulk, color to match fixture.
- F. Install each fixture in accordance with architectural details. Unless otherwise noted, each fixture shall be located symmetrically, with its center line congruent with the center of windows, stall spaces, wall spaces, or casework. Unless noted otherwise, mounting height of fixtures shall be in accordance with the manufacturer's rough-in Standards.
- G. Provide escutcheon plates for all lines through the walls and floors.
- H. Attach floor-mounted water closets to the floor with solid brass closet bolts, not brass plated.
- I. Connect hot water circulating piping to hot water piping within 24" of plumbing fixtures. Bring circulating piping down into wall as needed to meet this distance

requirement.

- J. Install carrier bolts in cured concrete only; test and prove to the Owner's representative that all carrier bolts are secured in the floor. On the second floor and above, through-bolt the carrier feet with longer bolts, 2" x 2" heavy square washers, lock washers and double nuts. Contractor is responsible for following the manufacturer's installation requirements and the installation results.
- K. Test all Emergency fixtures for flow and temperature and give test results to engineer.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures so as to prevent splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

END OF SECTION

SECTION 23 00 10

GENERAL HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, and Division 01.
- B. This section of the specification applies to the entire mechanical work, both interior and exterior, as specified herein after and shown on the plans.

1.02 SCOPE

- A. Provide heating, ventilating, and air conditioning equipment, piping, ductwork, etc. as shown on Plans and as described in contract documents.

1.03 DEFINITIONS

- A. The term "approved equal" means final approval by the Owner's representative of a material or piece of equipment substituted for that which is shown in the specifications or plans.
- B. The term "provide" means the furnishing and installing of equipment (including connections and appurtenances) complete and ready for use.
- C. The term "Mechanical Contractor (MC)" and "Electrical Contractor (EC)" as used in these Specifications or on the Contract Drawings, refers to those subcontractors working under the direction of the "General Contractor (GC)."

1.04 INTENT OF DRAWINGS

- A. The drawings are diagrammatic and do not show the exact details and locations, nor all offsets in ductwork and piping. Contractor shall provide additional fittings, offsets and extensions in piping, ductwork and related mechanical insulation as required to meet the intent of the documents. Contractor shall include in his bid provisions to relocate or shift piping and ductwork where conflicts exist with Structural, Architectural, or Electrical.
- B. Refer to the complete set of Architectural, Structural, Electrical, and Civil Plans and Specifications for additional details of the work. Review Plans and Specifications of other trades to identify other requirements. Discrepancies shall be reported to the Owner's representative immediately before ordering material or beginning work.

1.05 COORDINATION

- A. Examine the complete set of drawings including all disciplines before work is started. Consult with each of the other Contractors regarding locations and spaces required for work and lay out work to avoid interference. Maximum clearance shall be maintained for service access and maintenance of all equipment. Failure to coordinate shall be justification to require Contractor, at his own expense, to move his work to provide the necessary space for the other contractors.
- B. Mechanical systems have space priority as follows, listed with highest priority first: Graded Drainage Piping, then Ductwork, Drainage Vents, Hydronic Piping, Domestic Water Piping. MC to make certain that priority access is maintained. This shall be coordinated by the GC and MC without assistance from Owner's representative, Engineer, or Architect.
- C. Contractor shall be responsible for his own coordination between all other trades. Development of Shop Drawings shall be a collaborative effort between the General Contractor, Mechanical Contractor, Electrical Contractor and all other subcontractors working on the project. Shifting of piping, ductwork and other mechanical items shall be the responsibility of the Team to maintain the intent of the documents. Submit shop drawings to the Owner's representative.

1.06 WORK IN OTHER SECTIONS

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

1.07 CODES AND REFERENCES

- A. Codes and Standards listed shall be the most current issue as adopted by the Local Jurisdiction. In the event of a conflict of codes, the most stringent code will apply.
 - 1. International Building Code (IBC)
 - 2. Uniform Plumbing Code (UPC)
 - 3. International Mechanical Code (IMC)
 - 4. Washington State Energy Code
 - 5. SMACNA Duct Construction Standards, Metal and Flexible
 - 6. National Electrical Code (NEC)

1.08 PERMITS AND FEES

- A. Obtain and pay for all permits, licenses and construction or utility fees. Furnish final certificate to Owner showing compliance with code requirements.

1.09 SCHEDULING

- A. Comply with requirements of General Specifications.

1.10 PRIOR APPROVALS

- A. Specifications have been written around equipment and material selected for this project based on quality, size, capacity, and performance required to meet building design criteria. Any equipment and/or material used in this project, that is not as specified, must have prior approval from the Owner's representative.
- B. Request for Approval must be submitted with substitution request form included in Division 0 to Owner's representative, a minimum of 10 calendar days prior to bid date. This letter shall be accompanied with complete information regarding items to be substituted.
- C. Those items that receive prior approval, will be listed in the Mechanical Addenda.
- D. Supplier, and/or Mechanical Contractor, shall be responsible for ensuring that substituted material or equipment is of the same size, quality, capacity, weight, and electrical characteristics as that specified. Any changes and costs required during construction, due to contractor's/supplier's neglect to properly select substituted equipment, shall be paid by the contractor/supplier.
- E. Prior approval to bid does not mean automatic final approval of material or equipment by the Owner's representative. Final approval will be given after final submittal data has been presented to Owner's representative, with complete information regarding weights, capacities, size, electrical requirements and quality.

1.11 MATERIAL AND MATERIAL SUBMITTALS

- A. All material used on the project shall be new material and free from defects. This Contractor shall submit catalog data and engineering data on all equipment as specified or having received prior approval.
- B. Material and equipment specified is designated by various manufacturer's catalog numbers. Acceptable alternate manufacturers are also listed. Such manufacturers are exempt from the 10-day prior approval clause of these specifications, but must submit standard submittal data for final approval as otherwise noted.
- C. Submittal shall be arranged in numerical order, according to specification section number and item number. Submittal shall be in PDF format complete with labeled bookmarks (minimum one per specification section).
- D. Submittal shall be as follows: Before ordering or installing any of the materials, this Contractor shall submit copies of complete information on the materials to be used on the project. Submittal shall include, but not be limited to, the following.
 - 1. Contractor's Cost Breakdown
 - 2. Complete List of Subcontractors and Suppliers
 - 3. HVAC Insulation
 - 4. All Air-Handling Equipment
 - 5. Heat Pumps
 - 6. Electric Duct Heaters
 - 7. Air Terminals
 - 8. Air Filters

9. HVAC Ductwork
10. Tests and Adjustments
11. Controls

- E. Owner's representative's review of submittals is for general conformance with the design concept and Contract Documents. Marking or comments shall not be construed as relieving the Contractor from compliance with the project Plans and Specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and assembly and for safe performance of his work.
- F. The Owner's representative will return one set of this submittal to the contractor showing any corrections, additions, and/or deletions. This Contractor shall resubmit those items that need to be corrected or added.

1.12 CONTRACTOR'S COST BREAKDOWN

- A. Mechanical Contractor shall submit, with the submittals, a cost breakdown of the major portions of his work, pursuant to the following outline.
1. Job organization and submittals.
 2. Outside site utilities.
 3. HVAC Equipment.
 4. HVAC ductwork and air terminals.
 5. HVAC piping and insulation.
 6. HVAC specialties.
 7. Tests and adjustments .
 8. Control system.

1.13 RECORD (AS-BUILT) DRAWINGS

- A. This Contractor shall maintain a set of Contract Drawings at the site on which the actual installed location of piping, equipment, etc., shall be shown in a legible, neat manner. This set of plans shall show actual dimensions (including depth of bury) of underground piping from construction lines, so they can be readily found after covering. Record drawings shall be the same size as contract drawings. This set of plans shall be submitted for final approval. Drawings shall be one full size set, one half size set and on a USB flash drive in color PDF. The contractor shall be ready for review of the on-site as-builts monthly prior to submitting his billing. Failure to have drawings available for review may delay monthly billings.

1.14 OPERATING INSTRUCTIONS

- A. Operate all systems through complete cycles in the presence of designated Owner's representative. Give instructions for operation, care and maintenance. All systems shall be operated through complete operating cycles for a minimum period of 7 days in conjunction with the designated Owner's representative before acceptance.

1.15 TRAINING

- A. The Mechanical Contractor shall digitally record all Owner Mechanical training sessions and shall provide copies on USB flash drives. Training sessions shall be provided for all mechanical systems. Three copies of these USB drives shall be turned over to the Owner at the completion of the project.

1.16 OPERATION AND MAINTENANCE MANUALS (O&MS)

- A. General: Provide one preliminary searchable PDF set of Operation and Maintenance Manuals including maintenance information and parts list furnished by the manufacturer with the equipment, together with supplementary drawings where necessary, to itemize serving and maintenance points. Include the Valve Tag list as posted in the Mechanical spaces. Filter list shall include all sizes and quantities for each unit and recommended filter maintenance schedule. Include methods of operation, seasonal requirements, manufacturer's data and warranty forms. Warranty forms are to be located in the front of the manuals as well as in each applicable specific section. Provide address and 24-hour phone number of the firms responsible under warranty. Items requiring service or correction during the warranty period shall be serviced within 24 hours of notification by Owner. Data in manuals shall be neat, clean copies, with operation and maintenance instructions for each item of equipment installed. Drawings shall be accordion folded. An index shall be provided with all contents listed in an orderly presentation with bookmarks according to specification section.
- B. Number of Copies: A preliminary set of the O&M Manuals shall be submitted for approval. After this set has been approved, one hard copy and 3 electronic copies on USB flash drives shall be submitted.
- C. Hard Copy Binding: Organize operating and maintenance data into suitable sets of manageable size. Copies shall be submitted in 3-ring binders. Covers shall include the name of the Job, Owner, Architect, Engineer, Contractor, and the year of completion. The back edge of the binder shall include a label with the name of the Job, the Owner and the year completed. Each copy shall have a typewritten index and tabbed dividers between equipment categories. Binders to be no more than 80% full; binders that are over 80% full will be sent back for dividing into additional binders.

1.17 CERTIFICATIONS

- A. Provide written certification that work has been fully completed in strict accordance with Plans and Specifications and request final inspection.
- B. Provide written certification that Contractor will replace materials and workmanship that prove defective for one (1) year after date of acceptance or extended warranty as listed in individual sections.
- C. Provide written certification of inspection from the Authority Having Jurisdiction, stating that all work has been inspected, accepted, and approved as complying with existing governing ordinances and codes.

- D. Provide written certification that Owner's representative has been fully instructed in the operation and function of all mechanical systems.
- E. Provide copies of certification in the O & M Manuals.

1.18 DOCUMENTS

- A. Present the following documents to the Owner's representative prior to final acceptance of buildings. Final payment of the Contract will be contingent upon receiving these documents:
 - 1. Record (as-built) drawings.
 - 2. Operation and Maintenance Manuals (3 sets).
 - 3. Final material submittal.
 - 4. Warranties and Extended Warranties.
 - 5. Approved Final Balancing logs.
 - 6. Final certificates of inspection and code compliance.
 - 7. All applicable forms required by these specifications.
 - 8. Provide copies of the above documents in O & M Manuals.

1.19 WARRANTY

- A. All mechanical equipment and systems including Heating, Ventilating, and Air Conditioning systems, including controls and all parts thereof, shall be warranted (parts and labor), for a period of one (1) year after the date of substantial completion as determined by the documentation.
- B. Contractor shall repair or replace to the satisfaction of the Owner's representatives any defective material, equipment, or poor workmanship, which may show itself during this warranty period.
- C. All compressors used in HVAC equipment shall have an additional four-year parts warranty.
- D. Controls shall be warranted for two (2) years total parts and labor, from date of final acceptance.
- E. Test and Balance shall be warranted for two (2) years total, from date of final acceptance.

1.20 REQUIREMENTS PRIOR TO OCCUPANCY - OFF-GASSING AND BAKE-OUT

- A. Mechanical Contractor shall provide in his bid provisions for Off-Gassing and Bake-out of new materials installed in this contract. HVAC systems shall be run continuously for a minimum of two (2) week period prior to occupancy, at the completion of each area of the project. HVAC systems shall maintain a constant temperature of 70 to 78 degrees F, in all zones at 60% minimum outside air. Coordinate this requirement with the General Contractor.

1.21 MECHANICAL ACOUSTICAL REQUIREMENTS

- A. The noise criteria (NC) end resultant for each space shall be per Code as adopted by Local Jurisdiction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SUBMITTAL

- A. Owner's representative's review of submittals is for general conformance with the design concept and Contract Documents. Marking or comments shall not be construed as relieving the Contractor from compliance with the project Plans and Specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and assembly and for safe performance of his work.

END OF SECTION

SECTION 23 00 20

BASIC MATERIALS AND METHODS FOR HEATING, VENTILATING, AND AIR-- CONDITIONING

PART 1 - GENERAL

1.01 WORK INCLUDES

- A. General requirements for basic materials and methods.

1.02 REFERENCES

- A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- B. "Seismic Restraint Manual Guidelines for Mechanical Systems" by Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

PART 2 - PRODUCTS

2.01 GENERAL

- A. See specific sections for this requirement.

2.02 PRODUCT TESTING

- A. Any piece of equipment used in this project and hereinafter specified which, by its nature, requires electrical connection, such as fans, pumps, air handling equipment, etc., must be provided with an approval label from one of the agencies hereinafter listed.
- B. Approval of agency must be for the total package; approval of individual components not acceptable. All labels must be located outside of equipment and shall be visible to inspector. Comply with all requirements of RCW 19.28.010 and NEC Sections 90-7 and 110-3 (1993).
- C. It shall be the responsibility of the Mechanical Contractor or the equipment supplier to meet the requirements of this section. Any agency costs to provide an appropriate label for a piece of equipment must be included in this bid. Failure by Mechanical Contractor or supplier to obtain approval labels prior to bid shall be sufficient cause for the Mechanical Contractor/supplier to obtain all such labels at no additional cost to Owner. The following is a list of approval testing laboratories:
 - 1. Underwriters Laboratories, Inc., www.ul.com
 - 2. Canadian Standards Association, www.csagroup.org

3. Factory Mutual Systems, www.fmglobal.com
4. MET Electrical Testing, www.metlabs.com
5. Intertek Testing, www.intertek.com

2.03 PRESSURE VESSELS

- A. At the completion of the project, the Contractor shall provide State of Washington Certification of all pressure vessels installed on the project. Affix certification on the vessels and provide a copy to the Owner in the O & M Manual.

2.04 DAMAGED OR REJECTED MATERIALS

- A. Remove from the site immediately.

2.05 STARTERS, DISCONNECTS AND VFDS

- A. All starters shall be provided and installed by Electrical Contractor unless otherwise noted.
- B. All disconnects shall be provided and installed by Electrical Contractor unless otherwise noted.
- C. VFDs shall be provided by the Control Contractor, installed by the Electrical Contractor, and controlled by the Control Contractor unless otherwise noted.
- D. Mechanical Contractor shall coordinate VFDs, based on direction provided in the Contract Specifications. All VFDs are to be of a single manufacture and/or provided by a specific contractor. The MC shall be responsible for compliance with the specification or shall correct problems at his expense.
- E. The Mechanical Contractor shall coordinate with the Electrical Contractor and provide voltage, phase, horsepower, and amperage for all of the mechanical equipment being provided, based on approved submittals and the actual equipment being provided.
- F. Starters, disconnects, and VFDs shall be provided in a timely manner, so as to not delay the Electrical Contractor's work.

2.06 FIRE INTEGRITY

- A. Manufacturers
 1. 3M Fire Products
 2. Holdrite
 3. Approved equal
- B. The penetration sealing systems shall be provided with F-Rating and/or T-Rating as required by IBC Section 714.3 and 714.4 Penetrations include the following:
 1. Through-penetration firestopping in fire-rated construction.

2. Construction-gap firestopping at connections of the same or different materials in fire-rated construction.
 3. Construction-gap firestopping occurring within fire-walls, floor or floor-ceiling assemblies.
 4. Construction-gap firestopping in smoke partitions.
 5. Through-penetration smoke stopping in smoke partitions.
 6. Construction-gap smoke stopping in smoke partitions.
 7. All ductwork and piping penetrating mechanical spaces, mechanical mezzanines, mechanical lofts, mechanical boiler rooms, or other mechanical spaces, shall be fire caulked, even if the walls are not rated. Visible piping penetrations shall be covered by split chrome-plated floor and ceiling plates. Visible ductwork penetrations shall be covered by painted angle-iron frames.
- C. All products shall be listed in Underwriters Laboratory Fire Resistance Directory. Firestopping for penetrations and voids shall be UL-tested systems.
1. Through-penetration firestop devices (XHCR).
 2. Fire resistance ratings (BXUV).
 3. Through-penetration firestop systems (XHEZ).
 4. Fill, void or cavity material (XHHW).
- D. All material shall be tested per American Society for Testing and Material Standards, ASTM E814: Standard test method for fire tests of through-penetration firestops.
- E. Firestopping for penetrations and voids shall be UL-tested systems.

2.07 HANGERS

- A. Manufacturers:
1. Grinnell
 2. Michigan Hanger
 3. Tolco
 4. PHD
 5. Anvil
 6. Holdrite
 7. Approved equal
- B. Provide all anchors, hangers and all supports for piping and equipment included in contract.
- C. It is the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially-accepted pipe hangers and accessories.
- D. All pipe hangers and supports shall conform to the latest requirements of ASME B31.1 Code for Pressure Piping, and Manufacturers Standardization Society Documents MSS SP-58 and MSS SP-69.

2.08 INSERTS AT HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Holdrite
 - 2. Buckaroos
 - 3. Cooper
 - 4. Metro Supply Company
 - 5. Value Engineered Products, Inc.
 - 6. Hydra-Zorb Klo-Shure 7-series or 8-series strut-mount and Clevis
 - 7. Approved equal
- B. Insulated pipe inserts shall be provided at hanger, support, anchor, and guide locations on piping requiring insulation. The insert is to consist of either hydrous calcium silicate or polyisocyanurate foam insulation (urethane) encircling the entire circumference of the pipe with a 360-degree PVC (1/16" thick) or galvanized steel jacket (20 gauge minimum). Inserts are to be installed on piping during piping installation, by the Piping Contractor. Provide continuous insulation vapor barrier. Seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor retarder mastic.
- C. For elastomeric insulation, provide Hydra-Zorb Klo-Shure 7-series 8-series strut-mount or Clevis Hanger Insulation Couplings or approved equal.
- D. Insulation and covering shall meet the flame spread index and smoke developed index as noted in the International Building Code.
- E. Insert thickness shall match Code-required insulation thickness as a minimum.
- F. Provide pipe covering protection saddle for piping on rollers; Anvil figure 160 through 166A or approved equal.
- G. Inserts for piping in plenums shall have appropriate flame/smoke spread rating.

2.09 ELECTRIC MOTORS

- A. Minimum efficiencies of electric motors shall comply with the Washington State Energy Code.
- B. For VFD applications, provide motors rated for VFD service (inverter ready) only.

2.10 ACCESS DOORS AND PANELS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Milcor
 - 3. Mifab
 - 4. Approved equal.

- B. 16 gauge steel door and frame with concealed hinge and cylinder lock. Provide matching latches/locks keyed the same for multiple panels in a project. When "B" dimension is 24" or more, provide additional latches at the top and bottom of door. Provide finish and material as noted in Part 3 – Execution.

2.11 VIBRATION ISOLATION

- A. Manufacturers:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries
 - 3. Amber-Booth
 - 4. I.S.A.T.
 - 5. Flexicraft
 - 6. Twin City Hose
 - 7. Approved equal.
- B. General
 - 1. Size anchoring bolts to withstand lateral seismic shear and isolate bolts from direct contact with structure using bolt isolation washer and bushing.
 - 2. Bases specified in the schedule can be supplied by the manufacturer of the equipment if they meet the specification given herein.
 - 3. Electrical connections shall be made with floppy length of flexible cable.
 - 4. Piping in connected to vibrating equipment shall be supported from resilient ceiling hangers or from floor mounted resilient supports.
- C. Pipe Isolation - General
 - 1. Hung Type Isolators: Double-Deflection Neoprene Hanger to 4", Deflection - 30 degree Swing Spring and Double Deflection Neoprene Hanger - 6" and larger.
 - 2. Isolator Deflection: 1/4" to 4", 1" - 6" and larger.
 - 3. Motion Restraint Snubber: seismic restraint cable, rod clamp for standard 1-5/8" x 1-5/8" unistrut, and clevis cross brace.
- D. Piping not requiring sway bracing is as follows:
 - 1. Piping in mechanical spaces less than 1".
 - 2. Piping suspended by hangers 12" or less in length measured from the top of the pipe to bottom of hanger support where the hanger is attached.
- E. Air Handling Unit or Inline Fan - Up to 5000 CFM
 - 1. Hung Type Isolator: 1" Deflection - 30 degree Swing Spring and Double Deflection Neoprene Hanger.
 - 2. Flex Connector: Flexible duct connection manufactured from UL listed fire-retardant neoprene-coated woven glass fiber fabric to NFPA 90A, with minimum density of 30 ounces per square yard.
 - 3. Motion Restraint Snubber: Seismic Restraint - Cable.
- F. Air Cooled Condensing Units
 - 1. Base Type: Integral structural steel base. Structural steel support members with welded-on isolator support brackets and pre-located and

- drilled anchor bolt holes, supplied by the equipment manufacturer with the equipment.
2. Floor Type Isolator: Neoprene waffle pads, 40 durometer hardness, minimum 1/2"; maximum loading 60 psi.
 3. Flex Connector: Flexible pipe connection for refrigerant piping; see Section 23 23 00.

PART 3 - EXECUTION

3.01 LAYING OUT WORK

- A. Locate all general reference points as established by the General Contractor and take such action as is necessary to prevent their destruction; lay out work and be responsible for all lines, elevations, grading for utilities and other work executed under the Contract. Exercise proper precautions to verify figures shown on drawings, before laying out work and be responsible for any errors resulting from failure to exercise such precaution. The coordination of the utility installation with the final site grading and elevation by the General Contractor shall be the responsibility of this contractor. Locate existing utility lines which will be affected by the building location before any footing work begins. Report conflicts with the Plans to the Owner's representative for adjustment before proceeding with the work. Failure to follow this instruction will result in the contractor being required to alter his work at his own expense.

3.02 ELECTRICAL WORK

- A. All electrical work performed under this Section of the Specifications shall conform to all applicable portions of the Electrical Section of the Specifications, and shall conform to all applicable codes.

3.03 WORKMANSHIP

- A. Furnish and install all equipment for a neat and finished appearance. If, in the judgment of the Owner's representative, any portion of the work has not been installed in a workmanlike manner, or has been left in a rough, unfinished manner, Contractor will be required to remove and reinstall the equipment, and patch and paint surrounding surfaces in a manner satisfactory to the Owner's representative, without any increase in cost to the Owner.

3.04 EXCAVATION - GENERAL

- A. Perform all necessary excavation, shoring and backfilling required for the proper installation of work inside the buildings and premises, or outside as may be necessary. Slope sides of excavation to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

- B. Excess excavation shall be backfilled with gravel or sand and mechanically compacted to give full support to the piping. In case of sewer lines in rock excavation, the excavation shall be made at least 6" deeper than required and backfilled with sand to outside invert grades to provide cushion. No underground lines shall be covered until the installation has been approved by the Owner's representative, and the Authority Having Jurisdiction. Maintain sides and slopes of excavations in safe condition until completion of backfilling. All backfill shall be thoroughly compacted.
- C. No cinders shall be used for backfilling where steel, iron or copper piping is used. All trenches near or under footings shall be cut only after approval of the Owner's representative, and all backfilling of such trenches shall be according to his direction.
- D. All items of grading which will in any manner affect the bearing capacity of the soil foundations upon which will be placed floor slabs, walls, column footings or piping beds shall be performed to the satisfaction of the Owner's representative. All soil foundation areas which will in any manner support any of the above stated construction will be compacted by the use of mechanical tampers to at least 95% of the maximum density of the soil foundations, as determined by the compaction control test, in accordance with the "Method of test for Moisture Density Relations of Soils, ASTM Designation D1557." The moisture control at the time of compaction shall be uniform throughout the area and shall not vary more than 5% above or below the optimum moisture content as determined by the above described " Compaction Control Test." Place fill in 8" loose layers, each layer compacted.
- E. Division 31, (31 23 16 - Excavation, 31 23 23 Fill, 31 26 16.13 Trenching), shall provide Excavation, Fill and Trenching for the Mechanical Contractor, as needed to complete his work.

3.05 EXCAVATION DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations, and from a flooding project site and/or surrounding area.
- B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
- C. Establish and maintain temporary drainage ditches and other diversions, outside excavation limits to convey rain water and water removed from excavations to collection points or run off areas. Do not use trench excavation as temporary drainage ditches.

3.06 EXCESS EXCAVATION MATERIAL

- A. Dirt and debris from trench excavation shall be disposed of by this contractor, as directed by the Owner's representative.

3.07 PIPING INSTALLATION

- A. Lay piping in straight lines with uniform slope, leave no pockets. Care shall be taken to keep all foreign materials out of the piping during installation. Where ground water is present, provide suction pumps to keep trenches free of water, and cap ends of piping exposed to ground water when work is interrupted.
- B. All underground piping used for the distribution of HVAC systems located outside the building perimeter shall be buried a minimum of 36" from finish grade to top of piping.
- C. Piping and ductwork run above the floor SHALL NOT BE LOCATED OVER ELECTRICAL PANELS OR SWITCHBOARDS, except where located above a structural ceiling, or with drain pans approved by the AHJ. This piping includes, but is not limited to, heating water lines.
- D. All piping and ductwork SHALL BE ROUTED AROUND Elevator Equipment Rooms. Piping and ductwork may serve the room, but shall not pass through it. Follow all codes applicable to these areas.
- E. Isolation valves: Provide isolation ball or butterfly valves with positive shutoff on all inlets and outlets of all major pieces of equipment to facilitate serving and removal of such equipment without the necessity of draining the associated system. These valves are required even if not shown on the Plans.

3.08 OPENINGS IN PIPING AND DUCTWORK

- A. Keep all openings covered tightly with plastic during the work.

3.09 PIPE SLEEVES

- A. General: Provide pipe sleeves for piping passing through foundations, walls, floors, partitions, and roof to allow piping to pass freely through.
- B. Foundation Walls: Where piping passes through walls below finished grade, but does not enter the building spaces, the sleeves shall be Schedule 40 galvanized steel pipe. Provide a modular seal between the sleeve and the piping.
- C. Building Walls (Below Grade) and Floor Slabs: Where piping passes through building walls below grade, and floor slabs on grade or below grade, the sleeves shall extend a minimum of 1" inside the building wall or above the finished floor level, and shall be made watertight and gas tight by the appropriate modular seal. Sleeves shall be Schedule 40 galvanized steel pipe. If the sleeve and modular seal are subject to trapping water on the top side, pack with water resistant foam and

caulk with flexible caulking or grout.

- D. Building Walls and Floor Slabs (Above Grade) - New Construction: Where piping passes through concrete walls or floors within the building, the sleeves shall be of sufficient strength to withstand the pressure and concrete pouring operation without deforming or rupturing. Sheet Metal Ductwork with end slit and formed into flanges is not acceptable. Sleeves shall extend 1" above the finished floor. Sleeves in walls shall be flush on both sides.
- E. Piping Subject to Expansion: Where piping is subject to motion due to expansion, such as hot water heating mains, the sleeve shall be made large enough to allow free motion. Where piping passing through is insulated, the sleeve shall be large enough to permit the covering to pass through.

3.10 WALL/FLOOR PLATES AND ESCUTCHEONS

- A. Where piping or ductwork passes through any wall, floor or ceiling, it shall be fitted with chromium-plated steel escutcheons or stainless steel angle/trim rings for ductwork, with suitable set screws or other approved holding device. Where extended sleeves are necessary, the plates shall be of sufficient depth to cover the sleeves.

3.11 HANGERS AND SUPPORTS

- A. General
 - 1. Submittals: The Contractor shall submit, prior to installation, the following information and data for approval.
 - a. Data Sheets on all cataloged items to be used.
 - b. Sketches covering all specially designed hanger assemblies and fabrications.
 - 2. Where thermal movement will occur, the hanger assembly must be capable of supporting in all operating conditions. Accurate weight balance calculations shall be made to determine the supporting force at each hanger location, in order to prevent excessive stress on piping, ductwork, and/or equipment.
 - 3. Where piping or ductwork is to be supported from building steel, beam clamps shall be used. Beam clamp selection shall be for the required load and the configuration of the steel at the point of attachment. Drilling holes in the steel for hanger rod will not be permitted unless approved by the Structural Engineer. Use only adjustable side beam clamps (Type 25); standard beam clamps are not acceptable.
 - 4. Angle Clips: Where piping or ductwork is to be supported from building wood structure, angle clips shall be used with lag bolts sized to support the load in shear. Any attachment to wooden structural members shall be subject to the approval of the Structural Engineer.
 - 5. Hanger Rods: Hanger rod size shall be selected on the basis of loading from the following table:

3/8"	610#
1/2"	1130#

6. Hangers shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing. DO NOT BEND RODS.
 7. All rods shall be electro-plated to prevent corrosion.
 8. All rods shall be double-nutted with lock washer and cut washer, on both ends if applicable, and excess rod on the bottom shall be cut flush and ground for safety.
 9. Brackets and Racks: Where piping or ductwork is run adjacent walls or steel columns, welded steel brackets shall be used as base supports. Multiple pipe racks or trapeze hangers shall be designed and fabricated to suit conditions.
 10. Vibration Control: Provide a vibration control hanger within a mechanical room and at the first three hanger locations from any motor operated equipment. Hanger shall consist of steel frame and spring with neoprene washers.
 11. Auxiliary Steel: All auxiliary steel necessary for the installation of the hangers and supports shall be designed in accordance with the AISC Steel Handbook, furnished by the Mechanical Contractor, and shall receive one shop coat of primer paint.
- B. Hangers for Piping:
1. Riser Clamps (Vertical Piping): Piping shall be supported at each floor with a riser clamp or at sufficient intervals to carry the weight of the piping and that of its contents. Stacks shall be supported at their base by a concrete pier or by a suitable hanger located on the horizontal run, close to the riser. Riser clamp extensions shall rest on the building structure where possible; auxiliary steel supports shall be provided where it is impractical to rest directly on the building structure.
 2. Hanger Spacing for Piping: The maximum allowable spacing for pipe hangers shall be in accordance with the following. Where concentrated loads of valves, fittings, etc., occur, closer spacing will be necessary and shall be based on the weight supported and recommended loads for the hanger components.
 - a. Copper Tube and Piping - Soldered, Brazed or Welded.
 - 1) Horizontally: 1-1/2" and smaller, 6'; 2" and larger, 10'.
 - 2) Vertically - Each floor, not to exceed 10'. See note 1.
 - b. Notes For Above:
 - 1) Vertical water lines may be supported in accordance with recognized engineering principles with regard to expansion and contraction when first approved by the Authority Having Jurisdiction.
 3. Hangers - Horizontal Piping:
 - a. General: All hangers shall be provided with means of vertical adjustment. The following schedule shall be followed to select acceptable hangers for the type of service.
 - 1) Non-Insulated Copper Piping:
 - a) Copper Tubing Hanger
 - b) Copper Tubing Band Hanger

- c) Copper Tubing Clevis Hanger
 - 2) Insulated Copper Piping:
 - a) Adjustable steel Band Hanger with Shield.
 - b) Clevis hanger with Shield.
 - 3) Insulated pipe inserts shall be provided at hanger, support, anchor, and guide locations on piping requiring insulation. See paragraph "Inserts at Hangers and Supports" in this Section.
 - b. Trapeze Hangers: Where piping is grouped in parallel, provide manufactured strut or trapeze hangers consisting of two steel angles bolted back-to-back, with space between for a hanger rod at each end. Where the length of angles is greater than 24", there shall be three rod supports. Piping shall be able to move independently, and hanger spacing shall be dictated by the smallest pipe.
 - c. Anchors, Guides and Sliding Supports: Shall be as shown on the drawings or as necessary to prevent excessive stress in either piping or equipment.
- C. Hangers for Ductwork:
- 1. Reference and comply with SMACNA HVAC Duct Construction Standards - Metal and Flexible Table 4-1 - Rectangular Duct Hangers Minimum Size, and Table 4-2 - Minimum Hanger Sizes for Round Duct for the following:
 - a. Strap and Rod Sizes
 - b. Hanger Spacing
 - 2. Steel Cables
 - a. Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 602
 - b. Stainless-Steel ducts: Stainless steel complying with ASTM A 492.
 - c. End Connections: Cadmium-plate steel assemblies with brackets, swivel, and bolts designed for duct hanger service, with an automatic locking and clamping device.
 - 3. Duct Attachments: Sheet-metal screws, blind rivets, or self-tapping metal screws, compatible with duct materials.
 - 4. Support materials shall match ductwork materials (i.e. provide stainless steel support materials for stainless steel duct, galvanized steel support materials for galvanized steel ducts, and aluminum support materials for aluminum ducts).
 - 5. Hanger and Support Installation:
 - a. Reference Table 4-1 - Rectangular Duct Hangers Minimum Size, and Table 4-2 - Minimum Hanger Sizes for Round Duct.
 - b. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheetmetal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
 - c. Install upper attachments to structure. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.12 CUTTING AND PATCHING (NEW WORK)

- A. Furnish dimensions and locations of openings to other Contractors doing the work. Provide ample time to avoid delays and unnecessary labor. Cutting and patching made necessary to admit work, repair defective material or workmanship, or by neglect to anticipate proper requirements, shall be done by the General Contractor at the expense of the Mechanical Contractor.

3.13 ACCESSIBILITY

- A. Locate valves, damper operators, etc., so as to be easily accessible in mechanical spaces or through access panels, specified hereinafter. Otherwise, obtain Owner's representative's approval of location.
- B. Any equipment requiring maintenance clearances for servicing of filters, motors, compressors, etc., shall be carefully coordinated to avoid servicing problems. Failure of contractor to comply with this requirement shall be sufficient cause for contractor to make all necessary changes at no cost to the Owner. To avoid problems with interpretation of the NEC, allow 42" for all electrical clearances.

3.14 ACCESS DOORS AND PANELS

- A. Locations of panels shall be carefully selected during construction, so as not to be located behind cabinets, etc. Coordinate closely with the Architectural and Electrical Plans before installing panels.
- B. In painted walls, etc., access panels shall be prime-coated and painted by the General Contractor; install before surrounding surfaces have been painted. In other finished areas such as on ceilings, all access panels shall have the same type of finished surface as that of the surrounding area.
- C. Verify with the Owner's representative location and finish prior to ordering; failure to get the Owner's representative's approval may result in replacement of access panels at the Mechanical Contractor's expense. Minimum size of access doors is 12" x 12"; actual size depends on the specific circumstance, and panel shall be large enough to accomplish replacement or repair of the item requiring access. The Owner's representative shall have the final say on whether or not the access is of sufficient size.
- D. Provide access panels for all concealed valves for all piping.
- E. Doors shall have cylinder lock latches, all keyed alike.
- F. Provide fire-rated access doors for one-hour or two-hour rated walls and ceilings; units shall be UL labeled.

3.15 MECHANICAL ACCESSES

- A. Provide suitable access to all mechanical equipment requiring servicing, maintenance, replacement, or repair. In concealed spaces where access has not been provided by the Architect by means of doors, hatchways, walkways or other

means, provide wall or ceiling access doors of a type suitable to the Owner's representative, sized to provide easy access to all equipment. Location of such doors shall be coordinated with the work of the other trades, to avoid conflict therewith, and such locations shall be approved by the Owner's representative prior to installation of access panels.

- B. In addition to building access openings, provide access panels on ducts where required to service fire dampers, damper operators, and other associated equipment. All access doors providing access to mechanically furnished panels, control boxes and filter compartments shall be provided with fully-hinged, easily-opened access doors. Minimum size is 12" x 12", unless access area prevents that size. Consult Owner's representative prior to installing smaller sizes.

3.16 PAINTING, TAGS, ETC.

- A. Field painting of all mechanical equipment, piping etc., located in and exposed in occupied spaces, shall be by the General Contractor. See Architectural painting specification.
- B. Identification Tags: Provide identification tags for each main shutoff and control valve throughout the building indicating the system served. Tags shall be black phenolic plastic with white engraved inscription attached with chrome chain.
- C. Mechanical Room: Provide valve tag lists under glass, one for the Boiler Room and one for the remaining areas of the building. Coordinate location with Owner's representative.
- D. Each major item of Mechanical Equipment shall be provided with the name of the item, i.e., Exhaust Fan No. 2, etc., in labels of black phenolic plastic with white engraved inscription. Minimum size of lettering is 1" with a maximum of 2". Select appropriate sizes for the size of the equipment being labeled. Align labels with edges of equipment and locate labels so as to be visible. For ceiling exhaust fans, provide additional tag on grille.
- E. Pipe Markers:
 - 1. Piping throughout the building shall be equal to Brady Corporation No. B-946, M.S.I. No. MS-900, meeting or exceeding ANSI A13.10-1981. Pipe markers shall consist of two wraps of arrows in the direction of flow, color, and wording as indicated in the schedule following. Stencils shall be visibly located and spaced on maximum 20'-0" centers for long straight pipe runs. Stencils shall be located on both sides of a wall, within the first 3'.
 - 2. Color Code Schedule: (Service, Color, Stencil)

Condensate	Yellow COND
Refrigerant Liquid	Yellow RL
Refrigerant Gas	Yellow RG

3.17 TEMPORARY HEAT

- A. Heating equipment may not be used as temporary heating units during

construction.

3.18 FIRE INTEGRITY

- A. All penetrations of fire-rated walls, ceilings, roofs or floors via ductwork, piping and air terminals must be protected by fire dampers, fire/smoke dampers, appropriately-rated assemblies, and caulking to maintain integrity of structure.

3.19 CLEANING UP

- A. Comply with requirements of the General Specifications.
- B. Ducts shall be maintained as clean as possible during erection, and shall be blown clean before the building painting operations are started. Ducts and apparatus casings shall be thoroughly cleaned before fans and filters are operated. Installed ductwork and equipment openings shall be sealed to prevent contamination of construction dust, debris and moisture. Uninstalled ductwork and equipment shall be securely covered to prevent contamination or the insulation getting wet. Uninstalled ductwork and equipment shall be stored on pallets or dunnage that prevents water reaching the ductwork. If ductwork or equipment is found to be dirty or wet, this contractor shall be responsible for replacing such items. Contaminated or wet duct shall be spray painted with high visibility paint and removed from the site immediately. After equipment has been used for any purpose, such as adjusting, testing, or temporary ventilation, filters shall be replaced and exhaust/return ducts shall be cleaned. Use temporary filters with 80% to 85% filter efficiency during construction. Cover all openings with temporary filters if startup, test and balance, or commissioning starts prior to all work being completed in the building.
- C. Remove tags, shipping labels, etc., from all ductwork in exposed areas, whether ductwork is painted or not.

3.20 CAULKING

- A. Caulk all openings and flash around all piping, equipment, and ductwork passing through roof, floor, and walls. All caulking shall be water resistant. See also paragraph "Fire Integrity" for rated walls, ceilings, roofs, or floor penetrations.
- B. All piping and ductwork penetrations of walls, ceilings, and floors shall be caulked. A chrome-plated steel escutcheon plate shall be installed at each visible piping penetration of walls, ceilings, or floors. All duct penetrations of walls, ceilings or floors shall be flashed with 3" x 3" 18 gauge galvanized sheet metal angle for concealed ducts, and stainless steel angle for exposed ducts.

3.21 OPERATION OF EQUIPMENT AND SYSTEMS

- A. Contractor is responsible during all periods of balancing and testing. Provide temporary utilities as required.

3.22 TESTS, ADJUSTMENTS AND INSPECTION

- A. Test all work thoroughly and systematically, both during construction and after completion. Notify Owner's representative 48 hours in advance of all tests. Tests shall be maintained until approved. Tests shall be as hereinafter specified.
- B. The Contractor shall test the completed installation as in regular service. Any defects or imperfections that may show up are to be promptly corrected. The Contractor shall guarantee the entire system and all parts thereof for a period of one year from date of final acceptance. The Contractor shall repair or replace any part which may show signs of failure during that time, if such failure, in the opinion of the Owner's representative, is due to imperfections in material or to improper workmanship.
- C. No system, whether prescribed for testing or not, shall be covered or concealed below ground, in walls, in ceiling spaces, or generally from ease of viewing, without first notifying the Owner's representative. Failure to notify the Owner's representative for inspection of concealed systems shall be cause to require this contractor to uncover and recover such systems at no additional cost to Owner.
- D. A log of all tests shall be kept. The log shall note, dates, time of day test started, system or portion of system tested, length of test, test results, and who witnessed the test (AHJ, Owner's representative, or GC). Contractor shall insert legible name of witnesses. Contractor to submit a copy of the contractor's test log monthly to the Owner's representative.
- E. Review the project to determine when final inspection is appropriate and advise Owner's representative. Mechanical Contractor is required to complete his work before requesting final inspection.
- F. See specification section of piping used for test methods or procedures used.
- G. Conduct refrigeration leak test on all DX equipment prior to installation on or in buildings.

3.23 FINAL INSPECTION

- A. This contractor shall thoroughly review and inspect the project to determine when final inspection is required, and shall so advise the Owner's representative. It shall be understood that the work is to be essentially complete. If such is not the case and more than one final inspection and one backcheck are necessary, this Contractor may be billed for the additional backchecks at the then governing rate for the personnel involved. The final inspection punchlist shall be legibly signed on a copy of the punch list by a person responsible for the trade involved, and transmitted to the Owner's representative, before a backcheck will be scheduled.

3.24 PROTECTION AND CLEANING

- A. All equipment and material installed by this contractor shall be properly protected

from damage during the course of construction.

- B. In attic or other spaces where piping such as condensate drains, heating lines, refrigeration lines, etc. have been installed at floor level and interfere with foot traffic, the Mechanical Contractor shall provide covers to protect this piping. Wood or other such material will be acceptable. Where duct plenums or duct runs interfere with normal traffic patterns of maintenance personnel, the sheet metal contractor shall provide a wooden "bridge" over the ducts to prevent damage.
- C. Protect walking paths in mechanical spaces. Maintain 6'-8" headroom minimum, for all piping and ductwork. If required clearance is not possible, obtain permission from the Owner's representative to violate the above requirement, and comply with protective measures required.

3.25 SPECIAL PROTECTION

- A. Exercise maximum precaution to protect the building and equipment from damage of any kind, and in particular, prevent water and dust seepage into new equipment.

3.26 BALANCING WORK

- A. Provide Testing, Adjusting and Balancing as required in this section of the specification.

3.27 INSTRUCTION PERIODS FOR OWNER'S PERSONNEL

- A. Scope: Following installation of mechanical work, have representatives of installation tradesmen conduct demonstrations and instruction periods to point out locations of servicing points and required points of maintenance to Owner's representatives.
- B. General Description of Instruction Periods: Each period shall include preliminary discussion and presentation of information from maintenance manuals with appropriate references to drawings, followed by tours of building areas explaining maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures, temperature control settings, and available adjustments.
- C. Scheduling of Instruction Periods: Notice of Contractor's readiness to conduct such instruction and demonstration shall be given to the Owner's representative at least two weeks prior to the instruction periods, and agreement reached as to the date at which the instruction periods are to be performed. Advise Owner's representative two weeks prior to date when ready to conduct instruction and demonstrations; receive approvals of proposed date prior to making final arrangements.
- D. Schedule an additional instruction period for the off-season. That is, if initial instruction period takes place during the heating season, schedule another during the cooling season, or vice versa.

3.28 ON-SITE OBSERVATIONS AND SAFETY MEASURES

- A. During its progress, all work shall be subject to observation by the Owner's representative, and of the National Board of Fire Underwriters, State and Local Inspectors. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be totally responsible for conditions of the jobsite, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Owner's representative to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction" in the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the State and/or Federal Safety Inspector for interpretation whenever in doubt as to whether he is or is not in compliance with State and/or Federal regulations. Furthermore, the Contractor distinctly assumes all risk or damage or injury to any persons or property wherever located resulting from any action or operation under this contract or in connection with the work.

3.29 CONTINUITY OF BUILDING UTILITIES AND SHUTDOWNS

- A. General: Continuity of utilities services in the building shall be maintained at all times as required to provide heat, water, lighting, and power to all portions of the building. Utility systems shutdowns required for extensions, alterations or connections of new services shall be accomplished in accordance with the following requirements.
- B. Shutdowns: While building is in operation, utilities shutdowns shall be scheduled for weekends, holidays, or at night, if the shutdown affects the use of the building or surrounding buildings. The actual time and date is to be coordinated with and approved by the Owner's representative at least 72 hours in advance.
- C. Costs: The Contractor shall include in his bid proposal, all costs associated with utilities shutdowns. No extra payment will be made for overtime work, schedule changes, or failure to complete utilities connections within authorized shutdown periods.

3.30 DRAFT STOPS

- A. It shall be the responsibility of each contractor performing his trade to verify with Architectural Plans and to maintain the integrity of draft stops, whenever his work requires penetration of these areas. Patch as required to maintain integrity of draft stops.

3.31 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing equipment.
- B. Prepare a manufacturer's startup report, and turn over to the Owner's representative.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe Markers and Arrows.
- D. Ductwork Identification Nameplates.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.
- B. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification, including matching size and colored arrows.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Project Record Documents: Record actual locations of tagged valves, on As-Builts.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

PART 2 - PRODUCTS

- A. MANUFACTURERS

- B. Brady Corporation
- C. Seton Identification Products
- D. Marking Services, Inc.
- E. Approved equal

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height, Equipment: 1 -1/2".
 - 3. Background Color: Black.

2.03 VALVE TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- B. Tag Lettering: First Line = System Abbreviation; Second Line = Consecutive Valve Numbers, starting at 01.
- C. Beaded Chain: #6 x 4-1/2" - Nickel Plated.

2.04 PIPE MARKERS & ARROWS

- A. Color: Conform to ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Tape Pipe Arrows: Nominal sizes and colors to match pipe markers. 1", 2" and 4".
- D. Size of pipe markers:
 - 1. 3/4" to 1-1/4" OSD of Covering = 1/2" letters.
 - 2. 1-1/2" to 2" OSD of Covering = 3/4" letters.
 - 3. 2-1/2" to 6" OSD of Covering = 1-1/4" letters.
 - 4. 8" to 10" OSD of Covering = 2-1/2" letters.
 - 5. Over 10" OSD of Covering = 3-1/2" letters.

2.05 DUCTWORK IDENTIFICATION NAMEPLATES

- A. Description:
 - 1. Plastic Laminate 1-1/4" letters and arrows.
 - 2. Vinyl Markers 1-1/4" letters and arrows.
 - 3. Color per ASME standards.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install plastic nameplates and markers with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.
- B. Install tags with nickel plated chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions. Install a circular wrap of arrows at each end of the pipe marker.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Identify all mechanical equipment; air handling units, pumps, heat transfer equipment, tanks, and water treatment devices, etc. with plastic nameplates.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify ALL valves with tags.
- H. Tag automatic controls, instruments, valves and relays. Key to control schematic, show on control As-Builts. Provide tags identical to valve tags. First line = abbreviation [EMCS]. Number consecutively starting at 01.
- I. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, and flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20' on center for straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Identify all ductwork with plastic or vinyl nameplates. Identify with air handling unit identification number, system (Outside Air, Return Air, Exhaust Air, Supply Air, etc.) and area served. Locate identification as ducts leave or return to Air Handling Unit, on duct runs not to exceed 20' on center, adjacent each branch, at each side of penetration of structure or enclosure, and at each obstruction. air handling unit, at each side of penetration of structure or enclosure, and at each obstruction. Do not install labels on exposed ductwork.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Testing, adjusting, and balance of domestic water.

1.02 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council.
- B. ASHRAE Standard 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association.
- E. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. Qualifications: Submit name of Testing, Adjusting and Balancing agency and TAB supervisor within 30 days after award of the Mechanical Contract by the General Contractor. Include a list of the last 12 projects completed with a list of the respective Owner's representatives and a contact phone number for each.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1.04 DALT DUCT AIR LEAKAGE TESTING - ASSISTANCE

- A. M.C. to provide HVAC equipment mechanics to operate and assist with HVAC equipment and HVAC ductwork mechanics to provide the field required test ports and other modifications needed to perform the DALT. M.C. to ensure that these support personnel are present at the agreed upon times.

1.05 INSULATION PRIOR TO TAB OR DALT AIR LEAKAGE TESTING

- A. Do not allow insulating of ductwork or piping prior to TAB and or DALT testing. If project is behind schedule, the Owner's representative may agree to partial insulation prior to completion of testing, if the TAB contractor agrees.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. M.C. to provide conformed construction drawings and specifications to the TAB firm, if available. If not available, issue the same drawings that are being provided to the other Subcontractors, along with any RFIs or Change Orders that may affect their work. The M.C. is responsible to keep the TAB firm up to date with pertinent contract documents and correspondence.
- C. M.C. to provide approved equipment submittals and project schedule for the use by the TAB subcontractor.

1.07 WARRANTY

- A. Include a warranty for 24 months after final acceptance by the Owner, during which time the Owner may request a recheck, or resetting of any outlet, coil or device listed in the project test report. TAB contractor to contact other project subcontractors if their technical assistance is required to make any test or adjustments required. Maximum number of rechecks shall not exceed a yearly total of 5% of the entire project. However, if the balance reports are proved to be inaccurate, the Owner may request the entire project be re-balanced during the warranty period. The above warranty shall be included in the original contract bid proposal.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.

2. ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
1. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
- D. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.
- E. TAB Team Members: Submit their qualifications along with the Companies qualifications and the TAB Supervisor qualifications. TAB team approved to accomplish work on this contract, must be full-time employees of the TAB agency. No other personnel are allowed to do TAB work on this contract.
- F. Pre-Qualified TAB Agencies:
1. Neudorfer Engineering (206) 621-1810.
 2. Hardin & Sons (253) 952-0467.
 3. Air Balance Associates (206) 528-4788.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, have HVAC contractor replace or install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Confirm duct system leakage is minimized. Have HVAC contractor coat or recoat joints that may not be up to SMACNA standards prior to testing.

- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions, or that a letter allowing revised conditions has been received by the TAB contractor.
- D. The TAB contractor shall exercise care while performing his work so as to avoid damaging the work of other trades, particularly paint and ceiling tile. If damage is incurred by the Test and Balance Contractor, repairs shall be made at their expense.

3.03 PREPARATION

- A. For existing equipment, test existing to be refurbished or modified units prior to any construction work, record baseline system performance.
- B. Hold Pre-balancing meeting two weeks prior to starting TAB work.
- C. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Owner's representative and Owner's Commissioning Agent to facilitate spot checks during testing.
- D. Request HVAC contractor provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10% of design for supply, return, and exhaust systems.
- B. Air Outlets and Inlets: Adjust total airflow to within plus or minus 10% of design to space. Adjust outlets and inlets in space to within plus or minus 10% of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark locations where traverse and other critical measurements were taken on the Plans and cross reference the location in the final report.

- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order; replace belt guards, close access doors, close doors to electrical switch boxes, and restore thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner's representative and Owner's Commissioning Agent.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure performance capacity tests for all coils, confirm manufacturers capacities, single points test are acceptable for units below 7.5 tons, for units above 7.5 ton, average of multiple readings in compliance with acceptable standards, is required.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

- L. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- M. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05" positive static pressure near the building entries.
- N. At completion, be sure all test holes in low pressure duct have pressure sealing plugs installed; duct tape is not allowed. Test holes in high pressure duct shall employ threaded and capped duct air fittings.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust domestic water balancing valves and set aquastat setpoint, verify operation of aquastat and supply/return water temperatures on hot water recirculation systems.

3.08 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer
 - 2. Model/Frame
 - 3. HP/BHP
 - 4. Phase, voltage, amperage from nameplate
 - 5. Phase, voltage, amperage from actual, no load conditions.
 - 6. RPM
 - 7. Service factor
 - 8. Starter size, rating, heater elements
 - 9. Sheave Make/Size/Bore
- B. Pumps:
 - 1. Identification/number
 - 2. Manufacturer
 - 3. Size/model
 - 4. Service
 - 5. Design flow rate, pressure drop, BHP
 - 6. Actual flow rate, pressure drop, BHP
 - 7. Discharge pressure
 - 8. Suction pressure
 - 9. Total operating head pressure
 - 10. Shut-off, discharge and suction pressures
 - 11. Shut-off, total head pressure
- C. Air Cooled Condensers:
 - 1. Identification/number
 - 2. Location
 - 3. Manufacturer
 - 4. Model number

5. Serial number
 6. Entering DB air temperature, design and actual
 7. Leaving DB air temperature, design and actual
 8. Number of compressors
- D. Heat Exchangers:
1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Model number
 6. Serial number
 7. Entering/leaving temperature for outside air
 8. Entering/leaving temperature for exhaust air
 9. Heat exchanger pressure drop
- E. Cooling Coils:
1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Air flow, design and actual
 6. Entering air DB temperature, design and actual
 7. Entering air WB temperature, design and actual
 8. Leaving air DB temperature, design and actual
 9. Leaving air WB temperature, design and actual
 10. Saturated suction temperature, design and actual
 11. Air pressure drop, design and actual
- F. Electric Duct Heaters:
1. Manufacturer
 2. Identification/number
 3. Location
 4. Model number
 5. Design kW
 6. Number of stages
 7. Phase, voltage, amperage
 8. Test voltage (each phase)
 9. Test amperage (each phase)
 10. Air flow, specified and actual
 11. Temperature rise, specified and actual
- G. Air Moving Equipment:
1. Location
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Arrangement/Class/Discharge
 6. Air flow, specified and actual

7. Return air flow, specified and actual
 8. Outside air flow, specified and actual
 9. Total static pressure (total external), specified and actual
 10. Show filter static pressure, specified and actual
 11. Inlet pressure
 12. Discharge pressure
 13. Sheave Make/Size/Bore
 14. Number of Belts/Make/Size
 15. Fan RPM
- H. Duct Traverses:
1. System zone/branch
 2. Duct size
 3. Area
 4. Design velocity
 5. Design air flow
 6. Test velocity
 7. Test air flow
 8. Duct static pressure
 9. Air temperature
 10. Air correction factor
- I. Air Distribution Tests:
1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Area factor
 6. Design velocity
 7. Design air flow
 8. Test (final) velocity
 9. Test (final) air flow
 10. Percent of design air flow

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Glass Fiber Flexible Duct Wrap Insulation
- B. Plenum Waterproofing

1.02 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 23 31 00 - HVAC Ductwork and Casings:

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- I. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.
- K. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on-site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Do not store excess material in the building. Provide secure dry storage on-site, to store material.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION INSTALLED INSIDE BUILDINGS

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

2.02 MANUFACTURERS

- A. Knauf Fiber Glass
- B. Johns Manville Corporation
- C. Owens Corning Corp
- D. CertainTeed Corporation
- E. Pittsburgh Corning Corporation
- F. Armacell International
- G. Approved equal.

2.03 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Sorption: 5.0% by weight.
- B. Usage: HVAC Air Distribution Systems Ductwork - Interior - Medium to Low Temperatures.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
- E. Tie Wire: Annealed steel, 16 gage.

2.04 PLENUM WATERPROOFING

- A. Coordinate installation of a continuous self-adhering rubberized asphalt flashing, extend up each side a minimum of 6" and extend from the weatherproof louver back 4' or to the end of the plenum and up 6"; corners to be sealed watertight. Mechanical Contractor to provide certification letter stating Plenum Waterproofing has been installed in all plenums; provide a copy to the Owner's Commissioning Agent and Owner's representative.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that ductwork pressurization has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards; have a copy on site for reference. Employ only skilled tradesmen specializing in this kind of work.
- C. Insulated ductwork conveying air, below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

3.03 SCHEDULES

- A. Provide thickness of insulation to meet or exceed Washington State Energy Code and or local codes whichever are more stringent.
- B. See Schedules on drawings.
- C. Provide insulation thicknesses per Washington State Energy Code as a minimum.

END OF SECTION

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. General Requirements for Field Devices
- B. Automatic Control Dampers (Motorized Dampers)
- C. Automatic Control Damper - Actuators
- D. Control Panel
- E. Current Switch/Sensor
- F. Guards, General
- G. Intelligent Room Sensor with LCD Readout

1.02 RELATED REQUIREMENTS

- A. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.
- B. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc..
- B. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; National Electrical Manufacturers Association.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.
- E. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module used on this particular project..
- B. Manufacturer's Instructions: Provide for all manufactured components.
- C. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. Provide a two (2) year manufacturer's warranty on equipment, covering parts and labor.

PART 2 - PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. The following field devices may or may not be used on this project. See Section 23 09 23 Direct Digital Control System for HVAC and 23 09 93 HVAC Sequence of Operation for specific field devices required. The following alphabetical listing of field devices is provided to establish a quality and operating range for commonly used devices.
- C. Actuators, controllers, etc. shall utilize 24-volt DC power unless otherwise noted. Power to equipment requiring line voltage connection shall be coordinated with the E.C.
 - 1. Combination fire/smoke dampers, smoke dampers, etc., that are not connected to the Building Automation System shall be line voltage.
- D. Thermostats:
 - 1. Thermostats for small split systems are to be provided by M.C. from VRF/Split System equipment manufacturer.
 - 2. Where thermostats are located on exterior walls, provide insulating pad behind thermostat.

2.02 AUTOMATIC CONTROL DAMPERS (MOTORIZED DAMPERS)

- A. Manufacturers
 - 1. Ruskin
 - 2. Greenheck
 - 3. Vent Products
 - 4. Air Balance
 - 5. Johnson Control
 - 6. Honeywell
 - 7. Approved equal.
- B. General:
 - 1. Performance: Test in accordance with AMCA 500-D.
 - 2. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage.
 - 3. Jamb Seals: Spring stainless steel.
 - 4. Shaft Bearings: Oil impregnated sintered bronze.
 - 5. Linkage Bearings: Oil impregnated sintered bronze.
 - 6. Blade linkages shall be attached at mid-point of blade length.
 - 7. Maximum Pressure Differential: 6" wg.
 - 8. Temperature Limits: -40 to 200 degrees F.
 - 9. Provide actuators as required for application.
 - 10. Provide one actuator for every 20 sq. ft. of damper.
 - 11. Actuators shall utilize spring return on all outside air applications.
 - 12. Actuators shall be manufactured by Belimo or approved equal.
- C. Low Leakage Two-Position type
 - 1. Parallel blade type with construction and performance same as specified for low leakage modulating type.
 - 2. Airfoil blades shall be equipped with 0.50" minimum thickness axles, stainless steel or bronze sleeve bearings, field-replaceable EDPM or vinyl edge seals, and a flexible aluminum or stainless steel compression type jamb seal.
 - 3. Leakage shall not be greater than 4 cfm/square foot at 1.0" static pressure difference.
 - 4. Damper shall have a maximum operating static pressure differential of 6.00" and be capable of operating with face velocities up to 3,000 fpm.
 - 5. Unless otherwise indicated, dampers shall be same size as duct; where dampers are not installed in a duct, dampers shall be sized for a maximum pressure drop of 0.05" at maximum design airflow.
 - 6. Actuators shall be manufactured by Belimo or approved equal.
 - 7. Ruskin CD50 or approved equal.

2.03 AUTOMATIC CONTROL DAMPER - ACTUATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20% greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two-position control and for fail safe operation.

1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 2. Provide one operator for maximum 20 square foot damper section.
- B. Electric Operators:
1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
 2. Electric control actuation shall utilize direct coupled actuators. Belimo or approved equal.
 3. Damper actuators shall be Brushless DC Motor Technology with stall protection, bidirectional, fail-safe spring return (where shown on Plans or in sequence of operation as normally open or normally closed), all metal housing, manual override, and independent adjustable dual auxiliary switch.
 4. The actuator assembly shall include the necessary hardware and proper mounting and connection to a standard 1/2" diameter shaft or damper blade.
 5. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
 6. Actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with damper shaft.
 7. All actuators having more than a 100 lb-in torque output shall accept a 1" diameter shaft directly, without the need for auxiliary adapters.
 8. All actuators shall be designed and manufactured using ISO900 registered procedures, and shall be listed under Standards UL873 and CSA22.2 No. 24-93 I.
 9. Actuators shall be 120v. Provide with 120v/24v relay to allow for 24v signal from ERV controller to activate damper.

2.04 CONTROL PANEL

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face. Label panel and other devices.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

2.05 CURRENT SWITCH/SENSOR

- A. Solid state relay which senses AC current and outputs a DC current suitable for either a DDC digital input or analog input, as required for application. Veris, Hawkeye or approved equal.

2.06 GUARDS, GENERAL

- A. Heavy-duty plastic-coated metal type with secure backing plate, removable with a Phillips screw driver.
- B. Polycarbonate vented lockable guard for thermostats.
- C. Provide where shown on drawings or as required in the Sequence of Operation.

2.07 INTELLIGENT ROOM SENSOR WITH LCD READOUT

- A. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use - all within limits as programmed by building operator.
- B. The intelligent room sensor shall simultaneously display room setpoint, room temperature, outside (ambient) temperature, and fan status (if applicable) at each controller. This unit shall be programmable; site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
- C. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to Zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
- D. Provide Room Sensor with LCD readout for all rooms indicated by thermostat or labeled as such per the mechanical legend.

2.08 LIQUID IMMERSION TEMPERATURE SENSOR

- A. Temperature monitoring range: 20 degrees F TO 120 degrees F for cooling applications, and 70 degrees F TO 220 degrees F heating application.
- B. Output Signal: 4-20 ma DC.
- C. Calibration Adjustments: 0 and span (field adjustable).
- D. Accuracy at Calibration point: +/- 0.5 degree F.
- E. RTD Material: Platinum 100 ohm.

2.09 TEMPERATURE SENSORS

- A. All temperature sensors shall be solid state electronic, factory-calibrated to within 0.5 degree F, interchangeable with housing appropriate for application.
- B. Wall sensors to be installed as indicated on drawings. Mount 48" above finished floor.

- C. Duct sensors to be installed such that the sensing element is in the main air stream.
- D. Immersion sensors to be installed in wells provided by Control Contractor, and installed by Mechanical Contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors.
- E. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day. Provide element with sun shade to minimize solar effects. Mount sun shade at least 3" from building outside wall. Sun shade shall not inhibit the flow of ambient air across the sensing element. Shade shall also protect sensing element from snow, ice and rain.
- F. Duct (single point) temperature:
 - 1. Temperature monitoring range: / -20 to 120 degrees F.
 - 2. Output signal / Changing resistance.
 - 3. Accuracy at Calibration point: +/-0.5 degrees F.
- G. Duct Averaging temperature:
 - 1. Temperature monitoring range: -20 to 120 degrees F.
 - 2. Output signal: 4 - 20 ma DC.
 - 3. Accuracy at Calibration point: 0 .05 degrees F.
 - 4. Sensor probe length: 25' L.
- H. Outside air temperature:
 - 1. Temperature monitoring range: -40 to 120 degrees F.
 - 2. Output signal: 4 - 20 ma DC
 - 3. Accuracy at calibration point: +/- 0.5 degrees F.

2.10 THERMOSTATS

- A. Room Thermostat Accessories:
 - 1. Thermostat Covers: Brushed aluminum.
 - 2. Insulating Bases: For thermostats located on exterior walls.
 - 3. Thermostat Guards: Locking transparent plastic mounted on separate base.
 - 4. Adjusting Key: As required for device.
 - 5. Aspirating Boxes: Where indicated for thermostats requiring flush installation.
- B. Immersion Thermostat:
 - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
- C. Airstream Thermostats:
 - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 - 2. Averaging service remote bulb element: 7.5 feet.

- D. Electric High Limit Duct Thermostat:
 - 1. Snap-acting, single-pole, single-throw, manual reset switch that trips if temperature sensed across any 12 "of bulb length is equal to or above setpoint,
 - 2. Bulb length: Minimum 20'.
 - 3. Provide one thermostat for every 20 square feet of coil surface.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as, but not limited to, air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as, but not limited to, air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 48" above floor. Align with lighting switches and humidistats.
- C. Provide guards on thermostats in entrances, public areas, and where indicated.
- D. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- E. Mount control panels adjacent associated equipment on vibration free walls or free-standing unistrut supports. A single cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

- F. Install "HAND/OFF/AUTO" selector switches to override automatic interlock controls when switch is in "HAND" position.
- G. Provide electrical material, conduit, electrical wiring, and installation in accordance with the Divisions 26, 27, and 28.
- H. Provide insulating pad behind thermostat if thermostats are located on exterior walls.

END OF SECTION

SECTION 23 09 93

SEQUENCES OF OPERATION FOR HVAC CONTROLS

PART 1 - GENERAL

1.01 SCOPE

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections. These sequences are for use with an Energy Management Control System (EMCS), incorporating Direct Digital Control (DDC) for energy management, equipment monitoring, and control.
- B. Sequence of operation for:
 - 1. Alarm Reporting
 - 2. Dedicated Outside Air System (DOAS)
 - 3. Duct Heaters
 - 4. Ductless Split Systems
 - 5. Heat Pumps
 - 6. Motorized Dampers on Outside Air Ducts
 - 7. Night Setback
 - 8. Occupied Mode
 - 9. Optimum Start/Stop
 - 10. Wall Heaters
 - 11. Unoccupied Mode
 - 12. Warm-Up Mode - Mechanical Equipment
 - 13. Water Heaters - Domestic Water

1.02 RELATED SECTIONS

- A. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

1.03 SUBMITTALS

- A. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Provide 5-degree adjustable deadband to meet requirements of Washington State Energy Code.

3.02 DEDICATED OUTDOOR AIR SYSTEM (DOAS)

- A. Startup/Shutdown: The equipment shall be started and stopped based on an occupied and unoccupied schedule. This schedule and routine shall be capable of easy modification by any user. Upon fan shutdown, the outside damper shall close, exhaust air damper shall close, and return air damper shall be open.
- B. Morning Warm-up cycle: AHU shall remain inactive.
- C. Morning Cool-Down Cycle: The air handling equipment morning cool down mode shall start based on the optimum start time, but only if the previous recent historic log recorded afternoon outdoor temperatures above 75 degrees F. During morning cool-down, the outside, return and exhaust air dampers shall be allowed to operate normally and economizer cooling shall be energized.
- D. Night time Purge Cycle: During Night time Purge the zone cooling setpoint will be reduced to equal the zone heating setpoint. At 2:00 AM (adjustable) if the zone is scheduled to be occupied on this day, the zone will enter "Night Purge" mode. Economizers will modulate and fans will cycle and to meet the temperature Setpoint until Occupied mode begins. Heating is locked out. Occupied mode will run as normal to meet the temperature setpoint. Fans run continuously.
- E. Occupied mode: Unit will operate continuously to maintain space ventilation. Unit shall operate face/bypass dampers as needed for the energy recovery core to maintain LAT setpoint. Duct heater shall activate and modulate to maintain 65F LAT.

3.03 DUCTLESS SPLIT SYSTEMS

- A. Unoccupied mode: Unit shall remain disabled. Unit shall cycle to maintain space setback temperatures.
- B. Occupied mode: Unit shall be enabled and shall cycle upon call for heating/cooling to maintain space temperature heating/cooling setpoint.

3.04 MOTORIZED DAMPERS ON OUTSIDE AIR/EXHAUST AIR DUCTS

- A. Motorized dampers shall be provided on the outside air ducts (see Plans for locations). Dampers shall open when air handling units being served by that outside air source are energized and in an occupied or economizer mode.

3.05 NIGHT SETBACK

- A. Apply to each heating and ventilation zone.
- B. Night Setback shall be configured and interlocked with the building schedule.
- C. Night Setback temperature shall be adjustable.
- D. Building schedule shall be fully configurable allowing for each day and hour per year.

3.06 OCCUPIED MODE

- A. Cooling and heating equipment are enabled as suitable for ambient conditions.
- B. DOAS unit runs continuously.
- C. Sequence heat stages, dampers (on economizer cycle), and economizer cooling to maintain the discharge setpoint. Reset the discharge air temperature setpoint as needed to maintain the room temperature setpoint.
- D. Set exhaust air/outside air dampers to maintain 0.08 - inches WC, differential pressure. Coordinate with Testing and Balance contractor. Shut down fans on receipt of fire alarm condition.

3.07 OPTIMUM START/STOP

- A. Apply the Optimized Start/Stop program to each heating and ventilation zone.
- B. Optimized Start/Stop shall be fully configurable; provide all required hardware, sensors and programming to enable Optimum Start/Stop.
- C. Optimized Start/Stop shall automatically adjust start time for each individual unit to achieve setpoint temperature 30 minutes prior to occupancy.
- D. Building schedule shall be fully configurable allowing for each day and hour per year.

3.08 WALL HEATERS

- A. Maintain constant space temperature at 68 degrees F (adjustable) by cycling unit fan motor and energizing electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (adjustable).

- B. Restroom override. Unit temperature shall be capable of being overridden to a higher setpoint temporarily, unit shall revert back to the standard setpoint after the time has passed.

3.09 UNOCCUPIED CYCLE

- A. DOAS unit shall remain off
- B. Outside air and exhaust air dampers shall be closed.
- C. Heating system shall be off.
- D. Cooling system shall be off.
- E. If a zone requires heating to maintain the minimum night setback temperature, the appropriate equipment, shall be energized. The cooling system shall remain off. The heating system shall bring the zone up to the night setback minimum temperature. The outside air and relief air dampers shall remain closed.
- F. If a zone requires cooling to maintain the maximum night setback temperature, the appropriate equipment, shall be energized.
 - 1. If conditions suit the use of economizer cooling, allow economizer cooling to commence, open outside air damper and relief air damper. The heating system shall remain off.
 - 2. If economizer cooling is not appropriate, the mechanical cooling system shall operate to maintain night setback maximum temperature in the zone. The heating system shall remain off. The outside air and relief air dampers shall remain closed.
- G. Revert to temporary Occupied Mode when space temperature sensor night override button is pushed; override initially set at 2 hours (adjustable).

3.10 WARM-UP MODE - MECHANICAL EQUIPMENT

- A. Control system optimum-start controls shall provide warm-up switching for all items indicated as having a warm-up cycle. The outside air dampers shall remain fully closed during the warm-up cycle until the space temperature heating setpoint is reached or occupied period begins, whichever occurs first. After warm-up and 30 minutes prior to room occupancy, the outside air damper shall be opened to minimum outside air volume damper position as listed on Plans and as set by the Test and Balance subcontractor.

3.11 WATER HEATERS, DOMESTIC WATER SYSTEM

- A. Water heater shall remain in continuous operation (24/7) in order to avoid allowing growth of Legionella. Set water temperature as shown in Schedule on Plans. 140 degrees storage temperature is preferred.

- B. Occupied Mode: Water heater is enabled. Start hot water circulator before occupancy, initially set at 30 minutes (adjustable). EMCS shall monitor Hot Water Circulation Temperature using an aquastat. Provide aquastat to sense return water temperature and cycle the pump.
- C. Unoccupied Mode: Water heater is enabled and pump is off.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping
- B. Refrigerant
- C. Valves
- D. Flexible Connections
- E. Insulation
- F. Jackets

1.02 RELATED REQUIREMENTS

- A. Section 23 00 20 - Basic Materials and Methods; Inserts

1.03 REFERENCE STANDARDS

- A. ASHRAE Standard 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; (ANSI/ASHRAE Standard 15).
- B. ASHRAE Standard 34 - Designation and Safety Classification of Refrigerants; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- D. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers.
- E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- G. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

- H. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- I. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; and errata.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- K. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- L. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
- M. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
- N. UL 207- Refrigerant-Containing Components and Accessories, Nonelectrical
- O. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SYSTEM DESCRIPTION

- A. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gauge taps at compressor inlet and outlet.
- B. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- C. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Test Reports: Indicate results of leak test, acid test.
- D. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

- E. Submit certifications of compliance with ASME (BPV IX) for each welder.
- F. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.
- C. Each shipping unit of aluminum refrigeration tube shall be marked with metal or alloy designation, temper, size, and name of supplier; with soft straight lengths identified with a tag indicating that the product was manufactured in accordance with ASTM B210 and complies with ASME B31.5; and each hard temper straight length identified throughout its length by a marking not less than 3/16" in height and a legend spaced not greater than 3' on center that includes the designation "ACR" and pipe outside diameter. Each hard temper straight length shall be manufactured in accordance with ASTM B210 and comply with ASME B31.5.

1.07 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures shall conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide Welder Certification in accordance with ASME (BPV IX).
- D. Products Requiring Electrical Connection shall be listed and classified by UL as suitable for the purpose indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers; seal prior to shipment and keep sealed until connected into system.

PART 2 - PRODUCTS

2.01 PIPING

- A. Copper Tube: ASTM B 280, H58 hard drawn cleaned, dehydrated and sealed marked ACR on hard tempered straight tubing.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy, with between 5% & 15% silver.

- B. Condensate
 - 1. Copper Tube: ASTM B 88, Type L (B), drawn.
 - 2. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - 3. Joints: ASTM B 32, Lead Free Solder.

- C. Mitsubishi VRF System
 - 1. Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.
 - 2. Refrigerant pipe for CITY MULTI shall be made of phosphorus deoxidized copper, and has two types.
 - a. ACR Type-L "Annealed Temper": Soft copper pipe, can be easily bent with human hand.
 - b. ACR Type L "Drawn Temper": Hard copper pipe (straight pipe).
 - 3. The maximum operation pressure of R410A air conditioner is 4.30 MPa [623psi] . The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to recommend piping specifications in Mitsubishi Electric's engineering manual. Pipes of radical thickness 0.7mm or less shall not be used.
 - 4. Insulation: Refrigerant lines, as well as any valves, shall be insulated end to end with closed-cell pipe insulation, thickness as required by the Washington State Energy Code or local jurisdiction, whichever is more stringent.

- D. Pipe Supports and Anchors:
 - 1. Conform to ASME B31.5.
 - 2. Hangers for Pipe Sizes 1/2" to 1-1/2": Malleable iron adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2" and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3": Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Zinc plated.

2.02 REFRIGERANT

- A. Refrigerant: 410a, combination of difluoromethane (HFC-32) and pentafluoroethane (HFC-125) as defined in ASHRAE Standard 34. Verify with equipment manufacturer prior to charging.
- B. Other refrigerants are not to be used unless prior approval is obtained from the Owner's representative.

2.03 VALVES

- A. Manufacturers:
 1. Sporlan Valve Company
 2. Approved equal
- B. Ball Valves:
 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals. Maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

2.04 FLEXIBLE CONNECTORS

- A. Manufacturers:
 1. Circuit Hydraulics, Ltd.
 2. Flexicraft Industries
 3. Penflex
 4. Reflock
 5. Approved equal
- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9" long with copper tube ends; for maximum working pressure of 500 psi.
- C. Double braided stainless steel flexible pipe connections with Reflock end connections.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3; use molded tubular material wherever possible.
 1. Minimum Service Temperature: -40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.

- B. Usage: Refrigeration Piping - Interior / Exterior.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Interior pipe installations: No finish is required over concealed insulation indoors. Apply two coats of manufacturer's recommended finish, where insulation is exposed indoors.
- E. Inserts: Provide inserts at all support locations; see Section 23 00 20.
- F. Exterior pipe installations:
 - 1. Apply one coat of manufacturer's recommended finish
 - 2. Jacket
 - a. Zinc-coated sheetmetal ducting. SlimDuct RD-series or approved equal.

2.06 JACKETS

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic:
 - a. Compatible with insulation.
 - 3. Usage: Interior piping
- B. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
 - 1. Thickness: 0.016".
 - 2. Finish: 3/16 corrugated.
 - 3. Metal Jacket Bands: 3/8" wide; 0.010" thick stainless steel.
 - 4. Usage: Interior piping below 8'
- C. Lineset Covers
 - 1. Manufacturers
 - a. Fortress
 - b. SpeediChannel
 - c. SlimDuct
 - d. Approved equal
 - 2. Sized to cover refrigerant piping and insulation.
 - 3. Zinc-coated sheet metal ducting. SlimDuct RD-series or approved equal.
 - 4. Usage: Exterior piping.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Slope condensate piping to drain. Where air gaps are utilized cut condensate piping termination at 45 degree angle.
- D. Install piping to conserve building space and avoid interference with use of space.
- E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2" space between finished covering and adjacent work.
 - 4. Place hangers within 12" of each horizontal elbow.
 - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
 - 8. Provide vibration isolation hangers for all refrigeration piping. Refrigeration piping shall not be attached to the building structure.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Flood copper piping system with nitrogen when brazing.

- K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- L. Follow ASHRAE Standard 15 procedures for charging and purging of systems and for disposal of refrigerant.
- M. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass. Use bi-directional units for heat pumps.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Fully charge completed system with refrigerant after testing.
- R. Mitsubishi VRF Systems:
 - 1. Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.
 - 2. Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen according to manufacturer's installation instructions and warranty requirements. Test to no leakage.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Duct Materials
- B. Ductwork Fabrication
- C. Manufactured Metal Ductwork and Fittings

1.02 RELATED REQUIREMENTS

- A. Section 23 00 20 - Basic Materials And Methods for HVAC
- B. Section 23 07 13 - Duct Insulation:
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets.
- E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

1.03 REFERENCE STANDARDS

- A. ASTM A 36 - Standard Specification for Carbon Structural Steel.
- B. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.

- H. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.
- I. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.
- K. All codes and reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission of the Architect and Engineer. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. Meet or exceed SMACNA requirements for all sheet metal systems.

1.05 SUBMITTALS

- A. Product Data: Provide data for all materials.
- B. Shop Drawings: Indicate ducts, fittings, and particulars such as gage, sizes, welds, and configuration prior to starting work on systems. Duct design pressure rating is posted on contract drawings, shop drawings shall reflect pressure class as shown. Shop drawings are to clarify duct routing taking into consideration structural members, electrical equipment, and other mechanical equipment. Contractor to submit shop drawings for review.
- C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
- D. Manufacturer's Installation Instructions.
- E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.07 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, 90B, 96 and SMACNA standards.

1.08 FIELD CONDITIONS

- A. Do not install lined duct in wet locations. Contractor to keep ends of lined duct covered at all times. If lined duct becomes wet or dirty, remove from jobsite and replace with new duct. The General Contractor to provide weather protection if his schedule requires the sheet metal subcontractor to working ahead of the building being dried in.
- B. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Provide duct assemblies as shown on Plans.

2.02 MATERIALS

- A. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653 FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
- C. Insulated Flexible Ducts:
 - 1. Manufacturers:
 - a. Thermaflex Model G-KM
 - b. Approved equal
 - 2. Chlorinated polyethylene core supported by helically wound coated spring steel wire; fiberglass insulation; black polyethylene vapor barrier film.
 - a. Pressure Rating: 6" wg positive and 1" wg negative.
 - b. Maximum Velocity: 5000 fpm
 - c. Temperature Range: -20 degrees F to 200 degrees F continuous.
 - d. R-4.2, meeting UL 181, & NFPA 90A - 90B fire codes, self-extinguishing.
 - e. GREENGUARD certified for Children and Schools.
 - f. Acoustically rated.
 - g. Warranted for 10 years
 - h. Maximum length 6'.
 - i. Install per manufacturer's recommendations.

- j. Run insulated flexible duct as straight as possible.
- D. Ductwork: +/-2" w.g. pressure class, galvanized steel.
- E. Hanger Rod: ASTM A 36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and SMACNA High Velocity Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- D. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- E. T's, bends, and elbows: Construct according to SMACNA (DCS).
- F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- H. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide minimum 12" long plenum same size as the louver, sloped to drain to the exterior. Line plenum with self-adhering rubberized asphalt flashing as shown on Plans; seal plenum to louver frame and duct. Connect duct to plenum with 45 degree divergence fittings.
- J. Contractor may use the Ductmate connection system at his option. System consists of flanges with integral sealants, corner pieces, clips, bolts, cleats and gaskets.

2.04 MANUFACTURED METAL DUCTWORK AND FITTINGS

- A. Manufacturers
 - 1. Metal-Fab, Inc.

2. SEMCO Incorporated
 3. United McGill Corporation
 4. Local shop fabrication by installing contractor.
 5. Approved equal
- B. Manufacture in accordance with SMACNA HVAC Duct Construction Standards as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated on drawings.
- C. Single Wall Round Duct And Fittings: Materials shall be per SMACNA HVAC Duct Construction Standards, Metal and Flexible, Galvanized Sheet Metal. Provide spiral duct.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. General:
1. Install in accordance with manufacturer's instructions.
 2. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
 3. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
 4. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 5. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
 6. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 7. Use crimp joints with or without bead for joining round duct sizes 8" and smaller with crimp in direction of air flow.
 8. Use double nuts and lock washers on threaded rod supports. Cut rods flush with second nut.
 9. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
 10. Connect diffusers to low pressure ducts directly or with 6' maximum length of flexible duct held in place with strap or clamp.
 11. At exterior wall louvers, provide minimum of 12" long plenum same size as louver and sloped to the exterior. Plenum shall be lined with self-

adhering rubberized flashing as detailed on Plans. Seal plenum to louver.
Connect duct to plenum with 45 degree divergence.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Duct Access Doors
- B. Duct Test Holes
- C. Flexible Duct Connections
- D. Motorized Dampers
- E. Sleeves For Ducts Through Non-Fire-Rated Walls
- F. Volume Control Dampers

1.02 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- B. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- C. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.01 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc.
 - 2. Greenheck Fan Corporation
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company
 - 5. Approved equal
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1" thick insulation with sheet metal cover.
 - 1. Less Than 12" Square: Secure with sash locks.
 - 2. Up to 18" Square: Provide two hinges and two sash locks.
 - 3. Up to 24" x 48": Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.

2.02 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.03 FLEXIBLE DUCT CONNECTIONS

- A. Wherever ducts make connection with any air-handling device such as supply fans, exhaust fans, etc., flexible connections shall be provided.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 ounces per square yard.
 - 2. Net Fabric Width: Approximately 2" wide.

2.04 MOTORIZED DAMPERS

- A. See Section 23 09 13 Instrumentation and Control Devices for HVAC.

- B. Dampers shall be full size of duct, be sealed between damper frame and duct, and shall operate without binding on duct wall. Provide access panels for motorized dampers, 12" x 12" minimum.
- C. Belimo operators are the only electronic operators accepted.

2.05 SLEEVES FOR DUCTS THROUGH NON-FIRE-RATED WALL

- A. Provide sheet metal sleeves around ducts, penetrating through walls or floors. Pack opening around duct with fiberglass and caulk with resilient acoustical caulk and then install 3" x 3" - 18 gage sheet metal closure angle all around duct, overlapping corners, secure to duct and wall. Caulk and install closure angle on both sides of wall. When insulated on the exterior, butt to closure angles. See Section 07 84 00 for Fire Caulking requirements, Fire Caulking installation by Section 07 84 00 Subcontractor or General Contractor.

2.06 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company
 - 4. Greenheck Fan Corporation
 - 5. Approved equal
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Volume Control Dampers, shall be installed on all branch duct take-offs to diffusers, grilles and registers. Do not provide or use dampers at the face of the diffuser, grilles or registers for balancing.
- D. Single Blade Dampers: Fabricated for duct sizes up to 6" x 30"
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8" x 72". Assemble center and edge crimped blades in galvanized channel frame with suitable hardware.
- F. End Bearings: Except in round ducts 12" and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30", provide regulator at both ends.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8" x 8" size for hand access, 18" x 18" size for shoulder access, and as indicated. Provide 4" x4" for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install combination smoke and fire dampers in accordance with NFPA 92A.
- F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent the equipment.
- G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- H. Provide balancing/volume dampers on all branch duct take-offs to diffusers, grilles, and registers. These will be used in addition to dampers at the face of the devices.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Ceiling Exhaust and Return Registers/Grilles.
- B. Wall Supply Registers/Grilles.
- C. Wall Exhaust and Return Registers/Grilles.
- D. Louvers, Mechanical.

1.02 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute.
- C. ASHRAE Standard 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- D. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- E. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, throw, drop, terminal velocity and noise level.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Test and rate air outlet and inlet performance in accordance with ASHRAE Standard 70.

- C. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Grilles/Registers/Diffusers
1. Titus
 2. Price Industries
 3. Kees
 4. Krueger
 5. Carnes Company
 6. Tuttle & Bailey
 7. Approved equal
- B. Louvers/Louvered Penthouses
1. Ruskin Manufacturing
 2. Greenheck
 3. Carnes Company
 4. Loren Cook
 5. Approved equal

2.02 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

- A. Type: Egg crate style face consisting of 1/2" x 1/2" x 1/2" grid core.
- B. Fabrication: Grid core consists of aluminum with mill aluminum finish.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Frame: steel frame for exposed installation directly on ductwork.

2.03 WALL SUPPLY/RETURN REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille with deflection as listed in the schedule.
- B. Frame: 1-1/4" margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions with factory off-white enamel finish.

2.04 DOOR GRILLES

- A. Type: V-shaped louvers of 20 gage thick steel, 1" deep on 1/2" centers.
- B. Frame: 20 gage steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.
- C. Color and finish type to be selected by Architect.

- D. Equal to Titus CT-700L.

2.05 WEATHERPROOF LOUVERS

- A. Louvers shall be furnished for installation in exterior walls as shown on the Plans. Louver blades shall be fabricated from anodized aluminum or galvanized steel sheets, and shall be provided with a frame of galvanized steel or aluminum structural shapes. Sheet metal thickness and fabrication shall conform to SMACNA HVAC Duct Construction Standards-Metal and Flexible. Blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Louver shall be provided with bird screen. Louvers shall bear AMCA Certified Ratings Seal for air performance and water penetration ratings as described in AMCA 500.
- B. Louver Types
1. 5" deep, extruded aluminum, Wind Driven Rain Louver, Equal to Greenheck EVH-501
 - a. Frame
 - 1) Downspouts and caulking surfaces provided.
 - 2) Wall Thickness: 0.081" nominal.
 - b. Blades:
 - 1) Vertical rain resistant style, 3/4" spacing
 - 2) 6005-T5 extruded aluminum.
 - 3) Wall Thickness: 0.050" nominal.
 - c. Screen: 3/4" x .051" expanded, flattened aluminum bird screen in removable frame. Screen adds approximately 1/2" to louver depth.
 - d. Mounting: Furnish with screw holes in jambs.
 - e. Finish: Architect/Owner to select finish from manufacturer's standard finishes.
 - f. Performance: Beginning point of water penetration shall be above 1250fpm free area velocity. Pressure drop shall be 0.15"WG at 900fpm free area velocity.
 - g. Variations
 - 1) Flange or extended sill as needed for installation in wall

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Air Terminals
1. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
 2. Terminals installed in suspended ceiling systems shall be attached or supported as required by the latest appropriate Building Code for "Suspended Acoustical Ceilings."
 3. Install diffusers to ductwork with air tight connections.
 4. Install insulated diffuser boxes as detailed on the contract drawings.

5. Install grilles and registers to ductwork with air tight connections. Use screws and foil tape only; do not use duct tape.
 6. Provide balancing/volume dampers on all branch duct take-offs to diffusers, grilles and registers.
 7. Paint ductwork visible behind air outlets and inlets matte black.
- C. Duct Openings: Where no grille, register, or diffuser is called out at duct openings, provide 1/2" hardware cloth over openings.
- D. Louvers
1. Louvers shall be installed in exterior walls utilizing framed or masonry openings. The duct or plenum attached to the louver shall have the bottom surface sloped toward the louver and shall be rigidly secured and sealed watertight to the exterior wall, such that any entrained water will drain through the louver. The louver frame shall be sealed watertight to building surface. See details on Plans.
 2. Install plumb, level, and free of rack and twist. Use only stainless steel fasteners to secure louvers to the building. Fasteners are to be removable from the exterior of the building.
 3. Flashings as required by building architectural details are to be provided by G.C. Caulk and make watertight.
 4. Provide 3" continuous galvanized closure angles and closure plates on inside head, inside jambs, and inside sill of exterior wall louvers. Caulk angles and plates prior to installation.
 5. Install self-adhering rubberized asphalt flashing (Ice & Water Shield or approved equal) on the interior of plenum as shown on the Mechanical Details.
 6. After installation, clean all exposed surfaces per manufacturer's recommendations and protect from damage until completion of project.

END OF SECTION

SECTION 23 72 23

AIR TO AIR ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air to Air Energy Recovery Units.

1.02 RELATED REQUIREMENTS

- A. Section 23 23 00 - Refrigerant Piping and Specialties

1.03 REFERENCE STANDARDS

- A. AHRI 270 - Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE)
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- E. AMCA 500-D - Laboratory Methods of Testing Dampers for Ratings.
- F. AMCA 500-L - Laboratory Methods of Testing Louvers for Ratings.
- G. AHRI 1060 - Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- H. ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- I. ASHRAE Standard 84 - Method of Testing Air to Air Heat Exchangers.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- L. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
- M. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 PERFORMANCE REQUIREMENTS

- A. Performance Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Standard 90.1.
- B. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.
- C. Scheduled Performance: ARI 210/240 Test Conditions. See schedule.

1.05 SUBMITTALS

- A. Product Data: Provide data with dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
- B. Shop Drawings: Indicate dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
- C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- D. Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.06 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Equipment shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- D. All wiring shall be in accordance with the National Electrical Code (NEC).

1.07 QUALITY ASSURANCE

- A. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- B. The residential energy recovery ventilator shall be Certified by the Home Ventilating Institute (HVI) under CSA 439. Both a heating and a cooling test must be run to demonstrate year round energy recovery.
- C. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
- D. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. The unit must pass commercial flammability requirements.
- E. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of five years from the date of purchase.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

1.09 WARRANTY

- A. Lossnay Ventilation Equipment
 - 1. The Lossnay® units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.
 - 2. The Lossnay® Energy Transfer Core shall have an additional nine year warranty against defects in material or workmanship. The total warranty period shall be ten years from date of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURES

- 1. Mitsubishi
- 2. Trane

3. Renewaire
4. Approved Equal

2.02 LOSSNAY VENTILATION SYSTEM (HEAT EXCHANGER)

A. General

1. The fresh air ventilation system(s) shall utilize the Mitsubishi Electric LOSSNAY total heat exchanger with outside air bypass damper and energy recovery ventilation. These units shall be selected in accordance with the building ventilation requirements.
2. The ventilation equipment shall be Energy Recovery Ventilator (s) (ERV) as manufactured by Mitsubishi Electric (From now on referred to as "Lossnay® ERV").
3. The Lossnay® ERV shall be equipped with an M-Net data network control and will be directly connectable to the City Multi M-Net Data communication control network and will be able to be electronically interlocked with City Multi indoor units.

B. General

1. The ERV unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, control circuit board and blowers with motors, filters, and insulated foam air guides. Each unit will have an automatic by-pass damper system for economic operation under certain conditions. The unit shall have factory installed control board with functions for local, remote, and optional control modes.

C. Unit Cabinet: The cabinet shall be fabricated of galvanized steel, and covered with polyurethane foam insulation as necessary with steel mounting points securely attached

D. Construction

1. The energy recovery component shall be of fixed-plate cross-flow construction, with no moving parts.
2. No condensate drain pans or drains shall be allowed and unit shall be capable of operating in both winter and summer conditions without generating condensate.
3. The unit case shall be constructed of 24-gauge steel, with lapped corners and zinc plated screw fasteners. The case shall be finished with textured, powder coat paint (GR90 case shall be constructed of G90 galvanized steel.)
4. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets.
5. Case walls and doors shall be fully insulated with 1 inch, expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.
6. The ERV cores shall be protected by a MERV-8 rated, spun polyester, disposable filter in both airstreams.

- E. Blowers:
 - 1. The unit shall be furnished with mutiple direct-drive centrifugal blowers running simultaneously supplying and extracting air at the same rate for balanced ventilation air flow.
 - 2. The blower motors shall be directly connected to the blower wheels.
 - 3. The blowers and motors shall be mounted for quiet operation.
- F. Heat Exchanger
 - 1. The Lossnay® heat exchanger element shall be constructed of specially treated cellulous fiber membrane separated by corrugated layers to allow total heat (sensible plus latent) energy recovery from the exhaust air to the supply air or from the supply air to the exhaust air as determined by design conditions.
 - 2. The Lossnay® element shall have protective filters installed at both the supply and exhaust sides with an access cover to allow easy maintenance.
- G. Bypass Damper
 - 1. The ERV shall have an automatic supply side by-pass damper to allow inbound ventilation air to by-pass the Lossnay® energy transfer core when outside weather conditions warrant.
 - 2. The mechanism for opening and closing the bypass damper shall be a 208V-230V synchronous electric motor through an actuator. The motor will drive a steel cable connected to an mechanical damper flap to allow fresh air to bypass the Lossnay® element.
 - 3. Supply and return air thermistor shall control the damper and may be interlocked with a Mitsubishi Electric PZ Series LCD remote controller.
- H. Filters
 - 1. The ERV shall be equipped with factory installed air filters located at each intake face (both supply and exhaust sides) of the Lossnay® core.
- I. Mounting
 - 1. Mounting of the Lossnay® ERV shall be as indicated in the plans and drawings. The ERV shall not require and condensate pan or receptacle nor condensate drain or piping. Mounting may be horizontal or vertical and the unit may be inverted as required by ductwork connection.
- J. Control
 - 1. This equipment shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system automatically with a remote controller.
 - 2. Provide with Lossnay PZ-62DR-EA programmable controller.
 - 3. Controller shall operate all functions including operating the outside air and exhaust air shut off dampers.
 - a. Dampers shall be powered with relays. Coordinate damper voltage with electrical contractor prior to ordering. Dampers power shall come from lossnay unit circuit.

2.03 VIBRATION ISOLATION

- A. Vibration Isolation: Provide whole unit vibration isolation with the energy recovery unit assembly.
 - 1. Utilize factory supplied vibration isolation kit following instructions.
 - 2. Provide flexible duct connections at unit duct flanges.
- B. Construct with appropriately-sized, seismic-rated, corrosion-resistant captive-spring isolators.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Provide a factory-trained technician to ensure operability of control systems.
 - 2. Installation, commissioning and testing shall be carried out by licensed installers in accord with all Codes and requirements.
 - 3. The installation of all units, duct work, all interconnecting control and power wiring, commissioning and testing shall be carried out by licensed installers in accord with all Codes and requirements.
 - 4. The installer shall supply, install, test and commission all interconnecting ductwork for the units.
 - 5. Slope outside air and exhaust air ductwork from units toward building exterior.
 - 6. Provide straight acoustical flex ductwork full sized of inlets and outlets to units for a minimum of 2' prior to making any changes in size or direction.
- B. Equipment Manufacturer's Participation in Startup
 - 1. Provide authorized startup technician to perform functional performance testing.

END OF SECTION

SECTION 23 81 01

TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electric Wall Heaters

1.02 RELATED REQUIREMENTS

- A. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 SUBMITTALS

- A. Product Data: Provide typical catalog of information including arrangements.
- B. Shop Drawings:
 - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
 - 2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 - 3. Indicate mechanical and electrical service locations and requirements.
- C. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 WARRANTY

- A. Provide five (5) year manufacturer's warranty on units, covering parts and labor.

PART 2 - PRODUCTS

2.01 ELECTRIC WALL HEATERS

- A. Manufacturers:
 - 1. Cadet
 - 2. INDEECO (Industrial Engineering and Equipment Company)
 - 3. Marley Engineered Products
 - 4. Qmark
 - 5. Approved equal.
- B. Fan forced electric air heaters shall be UL listed, self-contained and completely separate from the wall mounting can.
- C. Construction
 - 1. Element: Nichrome-type wire wrapped on mica insulators with a 16 amp rated, at 240V, high temperature manual power reset limit switch, and a one-time over temperature thermal back-up fuse
 - 2. Blower: Two-stage centrifugal blower isolated from the heating chamber.
 - 3. Grille: One-piece, 20-gauge construction with powder coat paint.
- D. Electrical Characteristics: See Schedule on Plans.
- E. Options
 - 1. Provide with wall can.
 - 2. Provide with integral thermostat.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.
- C. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Division 26.
- D. Wall mounted electric heaters shall be mounted at 12" AFF to the bottom of unit, unless otherwise noted.

3.02 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing unit.
- B. Prepare a manufacturer's startup report, and turn over to the Owner's representative.

3.03 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 81 27

SMALL SPLIT-SYSTEM HEATING AND COOLING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Manufactured Air-Source Split-System Heating and Cooling Units
- B. Indoor Units for Ductless Systems
- C. Outdoor Unit - Air Cooled Remote Condensing Unit

1.02 RELATED REQUIREMENTS

- A. Section 22 10 05 - Domestic Water Piping: condensate drain.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute.
- C. ASHRAE Standard 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- D. ASHRAE Standard 23 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- E. ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Including All Addenda (ANSI/ASHRAE)
- F. ASHRAE Standard 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- G. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

- I. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- J. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- K. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- C. Design Data: Indicate refrigerant pipe sizing.
- D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five (5) years of documented experience.

1.06 WARRANTY

- A. Provide five year manufacturer's warranty on units, covering parts and labor. Compressors shall have a warranty of seven years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Mitsubishi
- B. LG
- C. Samsung

- D. Daikin
- E. Approved equal.

2.02 SPLIT-SYSTEM HEATING AND COOLING UNITS

- A. The Heat Pump system shall be split system with variable speed inverter compressor. The system shall consist of an outdoor unit, and a matched capacity indoor section that shall be equipped with a wired wall-mounted, remote controller.
- B. Provide refrigerant lines between indoor and outdoor units, factory cleaned, dried, pressurized, sealed, and insulated. Provide insulation inserts as noted in Section 23 00 20.
- C. Performance Requirements: See Drawings for additional requirements.
 - 1. Efficiency: Energy Efficiency Rating (EER/SEER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Standard 90.1; seasonal efficiency to ASHRAE Standard 103, Washington State Energy Code, or local jurisdiction energy code, whichever is the most stringent.
 - 2. Air Handling: See schedule.
 - 3. Heating Performance Requirements: See schedule on Plans.
 - 4. Cooling Performance Requirements: See schedule on Plans.
- D. Electrical Characteristics: See schedule on Plans.
- E. Basis of design is Mitsubishi.

2.03 INDOOR UNITS FOR DUCTLESS SYSTEMS

- A. Indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit, in conjunction with the remote controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.
- B. Unit Cabinet: Casing shall be ABS plastic. Cabinet shall be designed for suspension mounting from above and horizontal operation. Indoor unit shall have removable mounting brackets. A mounting template with suspension bolt locations shall be furnished with indoor unit. Mounting bolts or threaded rod of 3/8" diameter shall be used to suspend unit and unit shall not require direct contact with ceiling or panel for proper operation.
- C. Fan: The indoor unit fan shall have multiple high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have multiple speeds plus AUTO fan setting. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and sensed space temperature.

- D. Vane: Unit shall include a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote control, and swing. The horizontal vane shall significantly decrease downward air resistance for lower sound levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.
- E. Filter: Return air shall be filtered by means of an easily removable, washable filter.
- F. Coil: The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Drain pan level switch, designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing. A drain lift mechanism (condensate pump), capable of lifting condensate 23-5/8" above the drain pan, shall be provided.
- G. Electrical: The electrical power shall be as noted on Plans. Power to the indoor unit shall be supplied from the outdoor unit; wiring shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.
- H. Condensate Pump: Provide with manufacture provided condensate pump mounted inside the unit.
- I. System Control:
 - 1. The control system shall consist of a minimum of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
 - 2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.
- J. Remote Controllers
 - 1. Wired Remote Controller (PAR-21MAA)
 - a. Include a built-in weekly timer with up to 8 pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan

Speed selector, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature changes shall be by increments of 1°F. Controller shall have the capability of controlling up to a maximum of 16 systems, as a group with the same mode and set-point for all, at a maximum developed control cable distance of 1,500 feet. The control voltage from the wired controller to the indoor unit shall be 12/24 volts, DC. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices.

- b. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.
- c. Indoor units shall be equipped with an optional "i-see® Sensor" kit for automatic response to adjust the set temperature and provide uniform comfort from floor to ceiling.

2.04 OUTDOOR UNITS - AIR COOLED REMOTE CONDENSING UNIT

- A. Outdoor Units: The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.
 - 1. Comply with AHRI 210.
 - 2. Refrigerant: R-410A.
 - 3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Standard 23 and UL listed.
- B. The outdoor unit shall be able to operate with a maximum height difference of 100 feet between indoor and outdoor units. System shall operate at up to a maximum refrigerant tubing length of 100 feet without the need for line size changes, traps or additional oil. Contractor to provide any additional required refrigerant for proper operation.
- C. The outdoor unit shall be capable of cooling operation down to 0°F ambient temperature without additional low ambient controls (provide with wind baffle).
- D. Cabinet
 - 1. Casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating.
 - 2. Provide mounting feet welded to the base of the cabinet, of sufficient size for stability.
 - 3. Provide with removable panel sections for servicing.
 - 4. The fan grill shall be of ABS plastic.
 - 5. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

- E. Fan
 - 1. Units shall be furnished with DC fan motor(s).
 - 2. Fan blade(s) shall be of aerodynamic design, and the fan motor bearings shall be permanently lubricated.
 - 3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard.
- F. Coil
 - 1. Condenser coil shall be of copper tubing with flat aluminum fins. The coil shall be protected with an integral metal guard.
 - 2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV). The LEV shall be controlled by a microprocessor-controlled step motor.
 - 3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than requirements of the Washington State Energy Code, Seattle Energy Code, or local jurisdiction energy code, whichever is more stringent.
- G. Compressor
 - 1. Compressor shall have variable speed inverter drive to control compressor speed. The compressor speed shall dynamically vary to match the room load.
 - 2. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.
 - 3. The compressor shall be mounted to avoid the transmission of vibration.
 - 4. The outdoor unit shall have an accumulator and high pressure safety switch.
- H. Electrical
 - 1. Power for the indoor unit shall be supplied from the outdoor unit.
 - 2. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
 - 3. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.
- I. Mounting Pad: Precast concrete pad, minimum of 4" thick, 4" larger in all directions than unit being mounted. Install level and plumb to the adjacent building, set unit on waffle pads and secure to concrete pad. Provide drainage around unit, do not allow unit to sit in water.

- J. Unit Guards: Precast concrete bollards, minimum of 6" diameter, bury a minimum of 36" into ground, set in concrete. Provide a minimum of two units at each exposed corner.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.
- D. Verify equipment locations on the drawing, and in the field, do not exceed the manufacturer's maximum refrigeration pipe length, including elevation and fitting allowance. MC to coordinate with GC, CC and EC, prior to rough-in.
- E. Verify equipment wiring and coordinate with EC, some units have power to one location, with a intertie between units and others have power to both unit locations, with control intertie.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local Authorities Having Jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Condensate piping shall be sloped to drain. Piping terminated with an airgap shall be cut at a 45 degree angle.
- D. Install refrigeration systems in accordance with ASHRAE Standard 15.
- E. Pipe drain from condensate to nearest floor drain. Piping shall be cut at a 45 degree angle at the termination point.
- F. Pressurize and test in accordance with manufacturer's installation instructions and warranty requirements.

3.03 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing unit.
- B. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire system.

- C. Prepare a manufacturer's startup report and turn over to the Owner.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electric Duct Heaters

1.02 RELATED REQUIREMENTS

- A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; Air-Conditioning, Heating, and Refrigeration Institute.
- B. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Including All Applicable Amendments and Supplements.
- D. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.04 SUBMITTALS

- A. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 - PRODUCTS

2.01 ELECTRIC DUCT HEATERS

- A. Manufacturers:
1. INDEECO
 2. Markel
 3. Brasch
 4. Greenheck
 5. Approved equal
- B. General: Voltage, size, KW, steps and control voltage shall be as scheduled on Plans. Three phase heaters shall have balanced phases.
1. Heaters shall be UL Listed for zero clearance and shall meet all NEC requirements.
 2. Type: Heaters shall be of the following configuration:
 - a. For Duct Mounting All Slip-in or Flanged
 3. Elements:
 - a. Open coil heating elements shall be 80% nickel and 20% chromium; steps shall be arranged to prevent stratification when operating at less than full capacity. Elements for draw-through air handling units shall be de-rated to 35 watts per square inch; blow-through air handling coils and variable volume reheat coils shall be de-rated to 25 watts per square inch.
 - b. Elements for Finned Tubular heaters shall have fins brazed to tubular sheath. Element wire shall be 80/20 Ni-chrome. Elements shall be protected against corrosion by a high-temperature aluminum coating. Terminals shall be sealed with silicone rubber to protect against moisture.
 4. Construction:
 - a. Element terminals shall be stainless steel; insulators and bracket bushings shall be nonporous ceramic and securely positioned. Terminals shall be machine crimped to elements.
 - b. Frame shall be constructed of heavy gauge galvanized steel with galvanized steel brackets, stiffening ribs and gussets spot welded to the frame.
 - c. Terminal box shall be spot welded construction with solid, hinged cover, totally enclosed, without louvers or grilles per the UL Standard.
 - d. Recessed terminal box to be provided when coils are installed in ducts with internal insulation or obstruction greater than 1".
 5. Direction of airflow: heaters shall be interchangeable for horizontal left or right or vertical up airflow except when position sensitive mercury contactors or SCRs are built-in. In these cases, airflow direction shall be as scheduled.
 6. Safety devices:

- a. Disc-type automatic reset thermal cutout shall be furnished for primary over-temperature protection.
 - b. For secondary protection, a sufficient number of replaceable thermal cutouts in the power lines shall de-energize elements if the primary cutout fails.
 - c. All safety devices shall be serviceable through the terminal box without removing the heater from the duct.
- 7. Wiring diagrams: a unique wiring diagram shall be furnished for each heater. Diagram shall include recommended supply wire gauges per NEC and fuse sizes. Typical wiring diagrams are not acceptable.
- 8. Built-in components:
 - a. Safety interlocking disconnect switch
 - b. Disconnecting break magnetic contactors
 - c. Transformer with primary fusing per UL
 - d. Pressure-type airflow switch set at 0.05" WC
 - e. Supplementary circuit fuses per NEC (one set of fuses per 48 amp circuit)
 - f. Separate load and control terminal blocks to accept conductors as shown on the electrical plan.
- C. Options; the following options are required:
 - 1. Over-temperature Protection
 - a. Manual Reset Thermal Cutout in control circuit in series with automatic
 - 2. Switching Devices And Controls
 - a. SCR (solid state modulating control)
 - b. Fan relay
 - c. Time Delay Relay

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - 1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.
 - 2. Arrange supports to avoid piercing drain pans.
 - 3. Provide airtight seal between coil and duct or casing.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level.
- E. Make connections to coils with unions and flanges.
- F. Electric Duct Heaters: Wire in accordance with NFPA 70.

3.02 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing unit.
- B. Prepare a manufacturer's startup report and turn over to the Owner.

END OF SECTION

SECTION 26 05 00

COMMON WORK FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 GENERAL REQUIREMENTS

- A. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Section.
- B. Provisions within the Specifications and Drawings describe minimum guidelines for electrical installations.
- C. All electrical installations shall comply with the code requirements of NFPA 70 (NEC), NFPA 72, NFPA 90, WAC/RCW, Americans with Disabilities Act (ADA) and all local codes and ordinances.
- D. Where industry standard design practices are published for use by design professionals, such guidelines shall be used as a minimum basis of design; e.g., IESNA Recommended Practices, BICSI Communication Distribution Standards, ANSI/TIA/EIA Standards and IEEE Publications.
- E. Electrical efficiency, life-cycle cost and maintainability of proposed systems shall be considered prior to product selection.
- F. Availability (lead times) and potential obsolescence shall be considered during product selection. Potential long-lead items shall be reviewed with the Owner's Representative.
- G. Specified items that are essential to a facility's functional use shall have locally available spare parts and service and not be at risk to be discontinued by the manufacturer for a minimum of 5 years.
- H. All low-voltage cables shall be labeled with computer printed, sleeve type, wire markers. The designation on the wire markers shall match those on the shop drawings.

- I. The Owner shall be instructed on the operation of all systems at substantial completion and again three months after the initial instruction period.

1.03 SUMMARY

- A. Provide supervision, labor, materials, tools, equipment/machinery, temporary power and lighting, and other services necessary to complete the work for complete operations described herein and as shown on the Drawings.
- B. The provisions and intent of the General Conditions, Special Conditions, and General Requirements apply to the work as if specified in this Section and other Sections of the Specifications. Provide the electrical work as indicated or specified in other Sections of the Specifications and Drawings of the Contract Documents.
- C. Execute electrical work in strict accordance with the latest edition of the National Electrical Code and governing local ordinances, codes, and regulations. Assure the strict conformity of electrical equipment, materials, construction methods, tests, and definitions with the established standards of the following in their latest adopted revision: Underwriter's Laboratories, Inc. (UL), and National Electrical Manufacturers Association (NEMA).
- D. Furnish and install all equipment in the Contract in harmony with other trades to provide completed systems with neat, finished appearance, using approved methods of the trade. Only good workmanship will be accepted. If, in the judgment of the Owner's Representative, any portion of work not installed in a workmanlike manner or left in a rough, unfinished condition, remove the equipment, reinstall same, patch and paint surrounding surfaces satisfactory to the Owner's Representative, with no increase in cost.
- E. Mounting details of equipment, devices, light fixtures, raceways, junction boxes and the like are not usually shown or specified. Provide per industry standard practice and code requirements as necessary for proper installation and operation the same as if herein specified or shown.
- F. Provide installation means and methods of all equipment, devices, light fixtures, raceways, junction boxes and the like per industry standard practice and code requirements as necessary for proper configuration and operation as if herein specified or shown.
- G. All installations shall comply with ADA requirements.
- H. Purchase permits, licenses, and approvals required for execution of the Work.
- I. Test the entire electrical installation to assure compliance with Codes and proper system operation.
- J. Electrical systems commissioning consists of static checks of component and system installations and actual testing of equipment conditions and functions.

- K. The Commissioning Authority shall review and approve, prior to use, all test procedures and forms used and shall witness a varying fraction of the checks and testing performed by the Contractor. The Commissioning Authority shall review the completed check and test documentation of the Contractor for all checks and tests.

1.04 CALCULATIONS AND LABELLING

- A. Provide complete Arc-Flash Hazards Calculation Report and label all equipment required per NFPA 70E to properly identify arc-flash hazards. Contractor is required to pay for and submit Arc-Flash Hazards Calculation to Owner's Representative and Engineer for review and approval prior to commencing work.
- B. Provide complete Overcurrent Protective Device Coordination Study Report and install all devices per settings contained in the Coordination Study Report. Contractor is required to pay for and submit Coordination Study Report to Owner's Representative and Engineer for review and approval prior to commencing work.

1.05 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code.
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace.
 - 3. NFPA 5000, 2018 Ed.
 - 4. NFPA 1, 2018 Ed.
 - 5. National Electrical Manufacturers Association (NEMA).
- B. Underwriters Laboratories (UL).

1.06 DEFINITIONS

- A. The terms "or other reviewed and approved Manufacturers", "or approved equal" and "or equal" means final approval by the Architect or Engineer of a material or piece of equipment substituted for that which is shown in the Contract Documents.
- B. The word "provide" as used in these Specifications or on the Drawings shall mean "furnish, install, and complete connection per factory instructions".
- C. The term Mechanical Contractor (M.C.) and Electrical Contractor (E.C.) as used in these Specifications or on the Contract Drawings, refer to those subcontractors working under the direction of the General Contractor (G.C.).
- D. The term "Engineer" shall refer to the licensed professional electrical engineer who is responsible for the preparation of the electrical documents.

1.07 EQUIPMENT

- A. All materials shall be UL listed and labeled.
- B. The interior of all electrical equipment shall be thoroughly cleaned prior to final acceptance.
- C. All equipment and receptacles shall have permanent panel name and circuit number on equipment, disconnects, coverplates, etc.

1.08 SUBMITTALS

- A. Approval Submittals:
 - 1. Statement of Manufacturer's Qualifications.
 - 2. Statement of Installer's Qualifications.
 - 3. Product Data: Submit and clearly identify product data, selection, and options.
 - 4. Shop Drawings: Submit all required shop drawings. Where product data and shop drawings are required for the work, submit both at the same time.
- B. Shop Drawings:
 - 1. Shop drawings produced in AutoCAD shall be provided for each low-voltage system (data, fire alarm, security, etc.) and specialty systems (lighting controls, etc.). Shop drawings shall show all device-to-device wiring. All as-builts shall be delivered in electronic format.
 - 2. Shop drawings shall be based on the final room numbers established by the Owner or Architect; not the room numbers shown on the Architectural Floor Plans.
 - 3. Provide as-built shop drawings for all systems. As-builts shall show the locations of all components, conduit runs and cables utilized.
- C. Quality Assurance Submittals:
 - 1. Test and Inspection Results.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Manual Content.
 - 2. Spare Parts and Materials.
- E. Substitutions:
 - 1. Conform to Division 01.
 - 2. The naming of a certain brand or make or manufacturer in the Specifications is to establish a quality standard for the article desired. The Contractor is not restricted to the use of the specific name brand or manufacturer unless so specified as "no substitution". However, substitution request is required and permitted only as specified in Division 01.
 - 3. The Contractor shall assume full financial responsibility for any and all additional expenses arising from the use of a substitute product.

1.09 QUALITY ASSURANCE

- A. General: These Specifications and Drawings are intended to cover a completed installation of systems. The omission of expressed reference to any items of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such labor and materials. Refer to the Drawings and Shop Drawings or other trades for additional details, which affect the proper installation of this work.
- B. Conform to requirements of NFPA 70.
- C. Conform to the latest edition of the NECA Standards for good workmanship in the electrical construction manual.
- D. Provide all equipment included and as necessary and in harmony with other trades to provide completed systems with neat, finished appearance, using approved methods of the trade. Only good workmanship will be accepted. If, in the judgment of the Owner's Representative, any portion of the work has not been installed in a workmanlike manner or left in a rough, unfinished condition, remove the equipment, reinstall same, patch and paint surrounding surfaces satisfactory to the Owner's Representative, with no increase in cost to the Owner.
- E. Before submitting bid, Contractor is strongly encouraged to visit the site and examine existing conditions by which to provide a complete and accurate bid.
- F. A Certified Testing Company shall perform the work of this Section and shall be qualified to test electrical equipment and is a NETA (National Electrical Testing Association) certified testing agency. The Certified Testing Company shall not be associated with the manufacturer(s) of the equipment or systems under test.
- G. The Contractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on this Project.
- H. Installer Qualifications: An authorized representative who is trained and approved by the manufacturer.

1.10 COORDINATION

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Section specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.11 WARRANTY

- A. Warranty workmanship and components of the work excluding incandescent and fluorescent lamps for a period of one-year from the date of final acceptance. Remedy any defects in workmanship and repair or replace any faulty equipment that fails within the warranty period without additional cost to the Owner. Assure cleanliness of lamps and fluorescent tubes and replacement of defective units at the time of final acceptance.
- B. Refer to other Sections for additional warranty requirements.

1.12 CLOSEOUT DOCUMENTS

- A. Conform to Division 01.
- B. As-Built Drawings: Maintain a set of full-size Contract Plans at the site on which all changes and "as-built" modifications are recorded. All marks shall be in red pencil in a legible, neat manner. These drawings shall be reviewed monthly prior to final approval of pay request. Upon completion of the Project, the Contractor shall submit these drawings for final approvals.
- C. Operation and Maintenance Manuals: Conform to Division 01.
- D. Warranties:
 - 1. Conform to Division 01.
 - 2. Submit one-year warranty on all materials under the Contract work (excluding lamps). Refer to other Sections for additional warranty requirements.
 - 3. Submit all subcontractor warranties.
 - 4. Submit all manufacturer warranties.

1.13 OPERATION AND MAINTENANCE MANUALS

- A. Provide Operation and Maintenance Manuals in accordance with Division 01.
 - 1. Provide one preliminary bound set of Operation and Maintenance Manuals including maintenance information and parts list furnished by the manufacturer with the equipment, together with supplementary drawings where necessary to itemize serving and maintenance points. Include periodic maintenance, methods of operation, seasonal requirements, manufacturer's data and warranty forms. Provide address and 24-hour phone number of firm responsible under warranty. Items requiring service or correction during the warranty period shall be serviced within 24-hours of notification by the Owner. Data in manuals shall be neat, clean copies, and posted on 8-1/2" x 11" sheets, typed, operation and maintenance instructions for each item of equipment installed. Drawings shall be accordion folded. An index shall be provided with all contents listed in an orderly presentation according to Specification Section.
 - 2. Number of Copies: The preliminary set of the O&M Manual shall be presented to the Owner's Representative for review of content. After this

set has been reviewed and accepted, two or as indicated in Division 01, additional copies shall be provided.

3. Binding: Binders shall be as specified in accordance with Division 01, or if not specified in Division 01, binders shall be single touch, locking, D-Ring Type. Covers shall be black printed with the name of the job, the Owner, Architect, Engineer, Contractor, and the year of completion. The back edge shall be imprinted with the name of the job, the Owner, and the year of completion. Each copy shall have typewritten index and tabbed dividers between equipment categories. Binder shall have sufficient capacity to contain all data sheets and not exceed 3/4 of fill capacity.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Schedule materials, equipment, and light fixture deliveries and make all arrangements as necessary to complete all work in accordance with the project construction schedules. Provide schedules of work to the Owner's Representative as directed during construction.
- B. Schedule deliveries and unloading to prevent traffic congestion, blocking of access, and interference with work. Arrange deliveries to avoid larger accumulations than can be suitably stored at site. Provide for continuity of supply to avoid change of supplier or change in brand of materials during any phase of work.
- C. Deliver packaged materials to site in manufacturer's original, unopened, labeled containers. Do not open containers until approximate time for use. Store materials at locations that will not interfere with progress of work. Arrange locations of storage areas in approximately order of intended use.
- D. Store materials in a manner that will prevent damage to materials or structure, and that will prevent injury to persons. Store cementitious materials in dry, weathertight, ventilated spaces. Store ferrous materials to prevent contact with ground and to avoid rusting and damage from weather.
- E. Provide documentation to the Owner's Representative for any claim of material, equipment and light fixture deliveries not able to meet construction schedules.

1.15 PROJECT CONDITIONS

- A. Field verify and examine existing conditions.
- B. Verify requirements for temporary electrical power and construction power. Temporary electrical power must be provided to keep existing facilities fully operational during construction. Contractor shall be responsible to insure compliance with this requirement.
- C. Verify requirements for permanent power and telecommunication service requirements.

- D. Identify existing conditions and requirements for cutting, patching, excavation, core drilling, etc.
- E. Include all costs to provide the electrical installation associated with the existing conditions for the best workmanship and operation according to the intent of the Specifications and Drawings.
- F. Report to the Owner's Representative any condition that might prevent the installation of the equipment in the manner intended.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Naming of manufacturers indicates the manufacturer's brand name is acceptable only if their product is in compliance with each and every provision of this Specification. Failure to comply will result in disapproval.
- B. Supplier and/or Electrical Contractor shall be responsible to ensure that material or equipment is of the same size, quality, capacity, weight, and electrical characteristics as that specified. The Contractor/Supplier shall pay any changes and costs required during construction due to Contractors/Suppliers neglect to properly select equipment.
- C. Notify Owner's Representative for an on-site visit to inspect material and equipment prior to installation.
- D. Materials and equipment shall be new, undamaged, and shall be UL listed for its use.
- E. Defects and damages of material shall be replaced, furnish any new material as necessary and install the system at the Contractor's expense.
- F. Furnish material and equipment samples when requested by the Owner's Representative, within 21-days of request.
- G. Non-approved material and equipment must be removed from the jobsite.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting the performance of the Work.

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

3.02 GENERAL

- A. Conform to Division 01.
- B. Provide conduit, wiring, and all components indicated on schedules and diagrams.
- C. Before any installation, devices or equipment can be directed or located by the Owner's Representative within 20-feet of the designed contract location without extra cost.
- D. Device or equipment mounting height given herein the Specifications, Contract Drawings, and/or documents are intended to provide general guidelines pursuant to industry standards. Such guidelines may not be exact or accurate and may or may not conflict with other trades installation without verification.
- E. Provide field coordination and verification with other contractors, trades, or any shop drawings, and ensure that such mounting heights if indeed are practical and feasible as not to conflict with other installation and construction. If conflicts are discovered at any time during the construction, report to the Owner's Representative immediately for resolution.
- F. If the Contractor fails to provide such coordination and field verification and results of erroneous installation, the Contractor shall remedy such installation per Owner's Representative direction, at Contractor's cost.

3.03 MANUFACTURER'S DIRECTIONS

- A. Apply, install, connect, and erect manufactured items or materials according to the recommendations, wiring diagrams, instructions of the manufacturer when such recommendations are not illustrated or in conflict with the Contract Documents.
- B. Furnish to the Owner's Representative on request, copies of manufacturer's recommendations. Secure approval of recommendations before proceeding with work.
- C. Keep at the site not less than one copy, in good condition, of manufacturer's recommendations, wiring diagrams, instructions, or directions, pertaining to work at the site. Inform involved personnel of requirements and availability of manufacturer's recommendations.

3.04 UTILITY STANDARDS

- A. All work associated with electrical power and telecommunications utilities shall be installed in accordance with the standards and specifications established by the serving utility.
- B. Contact electrical power and telecommunications utilities. Verify and coordinate work scope prior to commencement of installation.

3.05 CONTINUITY OF BUILDING AND UTILITY SERVICES AND SHUTDOWNS

- A. Continuity of utilities services in the building shall be maintained at all times as required to provide heat, water, lighting, and power to all portions of all buildings. Utility systems shutdowns required for extensions, alterations or connections of new services shall be accomplished in accordance with the following requirements.
- B. Shutdowns: Utilities shutdowns shall be scheduled for weekends, holidays, or at night if the shutdown affects the use of the Owner's buildings. The actual time and date will be coordinated with, and approved by the Owner at least 72-hours in advance. Contractor shall be required to provide temporary power as required by the Owner to keep facilities operational during utility shutdowns. Coordinate with Owner.
- C. Costs: Pay all costs associated with utilities shutdowns. No extra payment will be made for overtime work, schedule changes, or failure to complete utilities connections within authorized shutdown periods.

3.06 COORDINATION

- A. The drawings are diagrammatic and indicate generally the locations of materials and equipment. These drawings shall be followed as closely as possible. Coordinate the work under this section with the architectural, structure, plumbing, heating and air conditioning, and the drawings of other trades for exact dimensions, clearances, and roughing-in locations. Cooperate with other trades in order to make minor field adjustments to accommodate the work of others.
- B. Coordinate work with Ceiling Contractor so that above-ceiling work is completed, inspected and accepted by the Owner's Representative prior to ceiling installation.
- C. Verify counter heights with cabinet installer and cabinet shop drawings, prior to rough-in for outlets. Unless otherwise indicated, outlets are to be mounted 6" (on center) above counter or backsplash. Existing outlets to be extended to match new outlet installation height. Verify height with Owner's Representative of any location that will not accommodate mounting heights.
- D. Coordinate electrical work with mechanical installations. Connect power wiring to mechanical equipment through starters, contactors as required. Maintain

clearances around mechanical equipment to allow access for maintenance per NEC codes and local codes.

- E. Coordinate wiring interconnections for the complete operation of electrical-mechanical equipment to include items provided by other divisions. Examine equipment connection information with manufacturer's shop drawings and submittals.
- F. Provide detailed wiring diagrams for equipment and component interconnection when requested by the Owner's Representative.
- G. Verify with Mechanical Contractor for final mechanical equipment locations prior to work. Connect power wiring to mechanical equipment through starters, contactors, and VFDs as required.
- H. Refer to project Construction Schedules. Schedule each specific area so that the delivery of materials and equipment are such as to cause no delay in Construction Schedules. Include the premium cost of delivery of equipment and overtime work in order to comply with the Construction Schedule if necessary.
- I. Coordinate and verify exact locations of wiring devices, light fixtures, fire alarm and communication devices and equipment prior to beginning of rough-in.
- J. If directed by the Owner's Representative, the Contractor shall, without extra charge, verify with local inspectors or authorities having jurisdiction, and make reasonable modifications in the layout as needed to prevent conflict with work of other trades of for proper execution of the work.
- K. If directed by the Owner's Representative, the Contractor shall, without extra charge, provide layouts of equipment and details of mounting method for review, prior to installation to ensure proper execution of the work.

3.07 RACEWAYS

- A. One-line diagrams, risers, and conduit routing are schematic and are not showing exact physical arrangement of equipment or exact routing of conduit. Coordinate conduit routing with all other trades.
- B. Where indicated on Drawings, junction boxes and pull boxes are minimum requirements. Provide other fittings and pull boxes of adequate size in the raceway system wherever necessary or required by the National Electrical Code. Allow a maximum of four-quarter bends between pull boxes in each run of conduits.
- C. Provide expansion joint fittings for conduits passing through new or existing expansion joints installed between buildings. Verify exact locations and details of expansion joints prior to work.

- D. Coordinate conduit routing, pull box and equipment locations with other trades to avoid conflicts of equipment installations.
- E. All empty conduits shall have pull wires.
- F. Provide unistrut mounting channels, hanger rods, anchor bolts and fittings to support conduits and pull boxes.
- G. Work shall comply with National Electrical Code requirements.

3.08 MISCELLANEOUS

- A. Support all conduits and equipment in accordance with the National Electrical Code and the International Building Code.
- B. Cutting and Patching: Perform cutting and patching as may be necessary for the proper installation of the electrical work. Grout around raceway penetrations and fill anchor bolt holes or spalled areas. Core drill new penetrations through existing structural walls, ceilings, and floor slabs.
- C. Cleanup: The premises must be kept free of accumulated materials, rubbish, and debris at all times. Surplus materials, tools, and equipment must not be stored at the building. At the completion of the job, equipment and fixtures shall be left clean and in proper condition for their intended use.
- D. Trenching: Perform excavation and backfill as may be necessary for the proper installation of the Electrical work, unless noted otherwise on the Drawings.
- E. Demolition: Electrical demolition shall be performed by the Electrical Contractor as indicated on Plans and other sections of the Contract Documents.
- F. Installation Details: Prepare and submit to the Owner's Representative detail sketches indicating equipment installation information with locations and dimensions.
- G. Tests: Test wiring and electrical equipment to verify absence of grounds and short circuits and verify proper operation, rotation, and phase relationship. Demonstrate operation of all equipment in accordance with the requirements of this Specification and the manufacturer's recommendations. Perform tests in the presence of the Owner's Representative. Provide instruments and personnel required to conduct these tests.

3.09 DRAFT STOPS AND FIRE STOPS

- A. Verify with Architectural Plans and to maintain the integrity of the draft stops whenever work requires penetration of these areas. Patch as required to maintain integrity of stops.
- B. Maintain fire-resistance ratings of walls, partitions, floors, ceiling, or other fire separation barriers whenever work requires penetrations or openings for

equipment. Provide and use approved methods and fire seal material and fitting to maintain the fire resistance rating. Provide approved fire rated enclosures of double gypsum wall board for electrical panels installed in fire rated walls to maintain the wall fire resistance rating. Where panels are semi-flush mounted, provide painted oak wood trim.

- C. Locate devices horizontally a minimum of 2-feet apart on opposing sides of a fire separation wall to maintain fire rating of wall.

3.10 INSTRUCTION PERIODS FOR OWNER'S PERSONNEL

- A. Scope: Following installation of work, have representatives of installation tradesmen conduct demonstrations and instruction periods to point out locations of servicing points and required points of maintenance to Owner's Representatives.
- B. General Description of Instruction Periods: Each period shall include preliminary discussion, and presentation of information from maintenance manuals with appropriate references to Drawings; followed by tours of building areas explaining maintenance requirements, access methods, servicing and maintenance procedures, and equipment cleaning procedures, control settings and available adjustments.
- C. Scheduling of Instruction Periods: Notice of Contractor's readiness to conduct such instruction and demonstration shall be given to Owner's Representative at least two (2) weeks prior to the instruction periods, and agreement reached as to the date at which the instruction periods are to be performed. Obtain approvals of proposed date prior to making final arrangements.

3.11 GENERAL ELECTRICAL CHECKS AND TESTING

- A. Test wiring and electrical equipment to verify absence of grounds and short circuits and verify proper operation, rotation, and phase relationship. Upon request, demonstrate operation of all equipment in accordance with the requirements of this Specification and the manufacturer's recommendations. Provide instruments and personnel required to conduct these tests.
- B. Checks are intended to begin upon completion of a component or equipment installation. Testing generally occurs later when systems are energized or nearing that point. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system as soon as possible, including all construction checklists and may require retesting portions of the system once all components are fully functioning.
- C. The check and test procedures and record forms shall contain the following:
 - 1. The Subcontractor(s) executing checks or tests.
 - 2. A list of the integral components being inspected and tested, equipment tag numbers, manufacturer, model number, pertinent performance information / rating data.

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3. Test equipment used.
 4. Construction checklists associated with the components, if any.
 5. Any special required conditions of the check or test for each procedure.
 6. Items, conditions or functions to be inspected, verified or tested, the checks and testing method given and a place provided with results recorded.
 7. Acceptance criteria (or reference by specific table where the acceptance criteria is found).
 8. For each procedure, list the technician performing check or test and company, witnesses of the tests and dates of tests.
 9. Sampling strategies used.
- D. The test procedures for dynamic equipment like lighting controls, emergency generator or fire alarm shall contain more step-by-step procedures. The test procedures and forms for more static components like panelboards, switchgear, circuit breakers, transformers, etc., can be more checklist-like in format. For each piece of equipment, checks and test procedures and their documentation record forms may be different documents or combined in the same document, but checks and tests should be grouped.
- E. At the Commissioning Authority's discretion, if large numbers or repeated deficiencies are encountered, the Contractor shall test and troubleshoot all remaining systems at issue on their own before commissioning with the Commissioning Authority will resume.
- F. Sampling for Identical Units. When there are a number of identical units, at the Commissioning Authority's discretion, some or all procedures of a test for a piece of equipment or assembly may be omitted when these same tests on other pieces of identical equipment or assemblies were conducted without deficiency.
- G. Common Testing Requirements:
1. The following requirements apply to all electrical systems and features that are to be commissioned when referenced below. Tests shall:
 - a. Verify functionality and compliance with the design intent for each individual sequence module in the sequences of operation. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Test every step in every written sequence and other significant modes, sequences and operational features not mentioned in written sequences; including startup, normal operation, shutdown, scheduled on and off, unoccupied and manual modes, safeties, alarms, overrides, lockouts, and power failures.
 - b. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.
 - c. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.

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- d. Verify shutdown and restart capabilities both for scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).
 - e. When applicable, demonstrate a full cycle from off to on and no load to full load and then to no load and off.
 - f. Verify time of day schedules and setpoints.
 - g. Verify all energy saving control strategies.
 - h. Verify that monitoring system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.
 - i. Verify operator control of all commandable control system points including proper security level access.
 - j. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA test procedures shall be part of the testing requirements of this specification. Additional testing procedures may be listed in this Specification.
- H. Common Acceptance Criteria:
- 1. The following common acceptance criteria apply to all equipment, assemblies, and features:
 - a. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequences of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications. Verify that equipment operates within tolerances specified in: governing codes, acceptance criteria contained in the construction documents, manufacturer's literature and according to good operating practice.
 - b. Systems shall accomplish their intended function and performance.
 - c. All safety trips shall require a manual reset to allow a system restart.
 - d. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.
 - e. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.).
 - f. Other acceptance criteria is given in the equipment testing requirements articles or referenced standards.
 - g. Additional acceptance criteria will be developed by the Commissioning Authority when detailed test procedures are developed.
 - h. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA performance criteria shall apply.

- I. Load Balancing:
 - 1. Checks shall be made for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.
 - 2. Record all circuit changes on as-built drawings.
 - 3. Do not fabricate nameplates, or cover plate device labeling prior to load balance test and adjustments.

3.12 COMMISSIONING REQUIREMENTS

- A. The equipment and systems referenced in this Section are to be commissioned per Division 01 "General Commissioning Requirements" and per Section 26 08 00 "Commissioning of Electrical Systems". The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

SECTION 26 05 01

BASIC MATERIALS AND METHODS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Devices, material, equipment, enclosures, and assemblies shall be new, UL listed, approved, and suitable for its environment where used.
- B. Unless noted otherwise, wiring systems shall be installed in a complete raceway system.
- C. Determine the exact electrical requirements of equipment from the equipment suppliers prior to rough-in.
- D. All installations shall comply with ADA requirements.

1.03 REFERENCES

- A. National Fire Protection Association (NFPA) – www.nfpa.org:
 - 1. NFPA 70 – National Electrical Code.
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace.
- B. International Code Council – www.iccsafe.org:
 - 1. IBC – International Building Code.
 - 2. IFC – International Fire Code.
- C. National Electrical Manufacturers Association (NEMA).
- D. Underwriters Laboratories (UL).

1.04 EQUIPMENT FINISH

- A. Electrical equipment, control panels, and cabinets, shall be furnished factory painted in the manufacturer's standard colors unless otherwise specified.

- B. Unfinished materials and equipment except conduit, shall be cleaned, primed and painted by the Electrical Contractor as directed by the Owner's Representative in accordance with the Painting Section of the Specifications.
- C. The colors of exposed electrical materials and apparatus shall be as selected by the Owner's Representative.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

1.06 QUALITY ASSURANCE

- A. Source: For each type of material required for the Work of this Section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Make all necessary provisions for storing materials and equipment at the site to insure the quality and condition of the material to be installed. Utilize only new materials which are free of defects and which arrive at the jobsite unopened in the original container.

1.08 COORDINATION

- A. Coordinate location of raceways, supports, cable trays and electrical equipment with other trades.
- B. Determine the exact electrical requirements of all equipment from the equipment suppliers prior to rough in wiring. Refer any discrepancy between the Drawings and equipment requirements to the Architect for resolution prior to installation.
- C. Construction Observation: Advise the Architect at least two (2) full working days prior to the covering of concealed electrical work.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish all items of the materials, design, sizes, and ratings specified herein.

- B. All devices, equipment, enclosures, and material shall be UL listed, Engineer approved, and suitable for its environment where used.

2.02 RACEWAYS AND FITTINGS

- A. All raceways shall be 1/2" minimum and 3/4" minimum for homeruns.
- B. 3/4" raceways shall have no more than six (6) #12 AWG conductors.
- C. Minimize the use of flexible metallic conduit. Flexible conduit shall only be used for light fixture connections, interior equipment connections, expansion and seismic joints, and sound control. Flexible metallic conduit shall not be used in concealed locations.
- D. Electrical Metallic Tubing (EMT): Hot dipped galvanized or sherardized steel. Utilize compression type with insulated throat in interior locations and steel rain tight type in exterior locations. Cast metal shall not be used.
- E. Rigid Galvanized Steel (RGS): Rigid metal conduit shall be galvanized steel type. Conduit fittings and accessories shall be listed for use with RGS.
- F. Polyvinyl-Chloride (PVC): Rigid PVC conduit shall be used in ductbanks and encased in concrete where noted on Drawings.
- G. Flexible Steel Conduit: Interlocking single strip, hot-dipped galvanized or sherardized, liquid-tight when used in wet or damp locations. Fittings shall be screw wedge type or liquid-tight type depending on conduit type used. Provide grounding fittings for ground wire installation outside conduit.
- H. Concealed raceways shall be secured with heavy-duty, single-hole, steel straps. Nail-in style straps shall not be used.
- I. Exposed raceways shall be secured with heavy-duty, two-hole, steel straps.
- J. Exposed raceway running on roofs, surface mounted on building exterior within 10-feet of ground, walkways or stairs, exposed to weather or under covered walkways shall be galvanized rigid steel on rubber support pads with strut straps (not wood).
- K. Raceways shall be supported independently from the ceiling suspension system, cable trays, ducts, and piping.
- L. Pendant mounted groups of raceways shall be supported by 1-5/8" square preformed channel (Unistrut).
- M. Cap or plug the ends of below grade conduits to prevent concrete and other materials from obstructing conduits.

- N. Wherever buried, non-metallic, conduit passes through an expansion or contraction joint, or where required to compensate for thermal expansion and contraction, provide a conduit expansion joint. Install the conduit to cross the joint at right angles.
- O. Pull Wires: Provide a pull wire in all empty raceways:
 - 1. Use nylon pull-wires of tensile strength not less than 240-pounds in each conduit and duct, leave pull-wires in ducts and conduit after cleaning.
 - 2. No splices in pull-wire will be allowed.
 - 3. Leave ample slack length at each end of pull-wire.

2.03 PATHWAYS FOR LOW-VOLTAGE SYSTEMS

- A. Provide a complete pathway system for all low-voltage wiring. Pathways shall consist of "open" cabling supports (D-rings, J-Hooks, etc.), cable tray, or a combination of both. The extent of the cable tray shall be coordinated with the Owner's Representative.
- B. Pathways shall not include inaccessible spaces, unless a continuous conduit is provided through such spaces.
- C. Provide a pull wire in all empty raceways.
- D. Open Cable Supports:
 - 1. Where cables are to be installed as "Open Cabling", cable supports (D-rings, J-hooks, adjustable straps and saddles as appropriate) shall be installed to allow cabling to be grouped and run along a common path. Cables shall be run parallel or at right angles to the building structure, and shall not be looped diagonally across the ceiling space. Cables shall be loosely bundled with cable ties at a minimum every 36" O.C.
 - 2. J-Hooks: Shall comply with TIA requirements for structured cabling system, and have a galvanized finish; Caddy #CAT21 with CATHBA angled hanger bracket or equal. Follow manufacturer's recommendations for quantity of cables supported.
 - 3. Cable Tray:
 - a. Provide 18" wide x 4" deep aluminum ladder style cable tray with 9" rung spacing in all major corridors or as shown in Drawings.
 - b. Provide longitudinal and lateral seismic bracing.
 - c. All penetrations through rated walls shall be firestopped with removable, re-enterable fire stopping system. Fire stopping shall be the responsibility of the Electrical Contractor, not the individual low-voltage subcontractor(s). All conduits/penetrations should be sealed prior to ceiling cover inspection.
 - 4. Ground all cable trays as required per NEC.
 - 5. Do not run cable tray through rated walls or floors. Provide multiple 4-inch raceway sleeves through rated walls and floors to simplify fire stopping.

2.04 RACEWAY SLEEVES (FIRE-STOP DEVICES)

- A. Provide raceway sleeves as required or as indicated on Drawings for low-voltage cabling through walls and floors. Sleeves shall be Hilti model CP-653 or approved equal. Provide diameter size as required. Sleeves shall have the following features at a minimum:
 - 1. Shall be re-penetrable, high capacity cable management devices for low-voltage cable routing.
 - 2. Shall have the ability to re-penetrate from one side of the wall.
 - 3. Shall have 100% visual fill.
 - 4. Can be installed in wall and floor applications.
 - 5. Fire-rated for up to 3-hours in concrete and fire-rated up to 4-hours for gypsum walls.

2.05 WIRE AND CABLE

- A. Branch circuit wiring shall be #12 AWG copper minimum unless indicated otherwise. Conductors #10 AWG and smaller shall be solid copper with Code grade insulation and a minimum temperature rating of 75 deg C.
- B. Branch circuit ground wire, isolated ground wire, equipment grounding conductor and grounding electrode conductors shall be insulated the same as the circuit or feeder conductors.
- C. Conductors #8 AWG and larger shall be stranded copper, with Code grade insulation and a minimum insulation temperature rating of 75 deg C, and connected to equipment by means of compression type terminal lugs. Compression lugs shall be hydraulic compression only. Mechanical compression methods are not acceptable. Provide two-hole lugs of AL/Cu type only. Single hold lugs are not acceptable.
- D. Marking: Wire must be marked at 2' intervals with gauge, insulation type, and manufacturer. Label feeders at each end of phase designation.
- E. Low voltage wiring and cables specified herein by Divisions 26, 27, or 28 shall be installed either in complete raceway system or shall be plenum rated.

2.06 JUNCTION AND PULLBOXES

- A. Manufacturers: Bower, Raco or Steel City. Boxes exposed to weather shall be Crouse Hinds or approved equal cast aluminum type.
- B. Electrical boxes shall conform to UL-50, "Standard for Electrical Enclosures" and UL-514, "Standard for Electrical Outlet Boxes and Fittings".
- C. Provide electrical boxes of the material, finish, type, and size indicated and required for the location, kind of service, number of wires, and function.

- D. Electrical boxes that are shown on the Drawings with no indication of size shall be provided in accordance with the NEC.
- E. Junction boxes, pull boxes, and outlet boxes shall be pressed steel with knockouts and matching cover as required with size, depth, and shape best suited to the location and intended service. Cover on finish area shall be provided with specification grade quantity type to match finish surface. Include plaster or tile rings as required.
- F. Provide neoprene gaskets 1/8" thick with all boxes subjected to weather.
- G. Grounding: Provide each box with a grounding terminal.
 - 1. Grounding Terminal: Either a green-colored washer-in-head machine screw not smaller than 10-32 in a drilled and tapped hole in the back of the box or a grounding bushing with green-colored machine screw terminal attached to one of the conduits.
 - 2. Install grounding jumpers as specified in 26 05 26 "Grounding and Bonding".

2.07 SUPPORTING DEVICES

- A. Provide dedicated blocking and support method to ensure secure installation of all device boxes such that the installation is capable of withstanding a minimum 50-pound pulling force without moving.
- B. Support raceway by straps, suitable clamps or hangers to provide a rigid installation. Perforated strap hangers and twisted wire attachments will not be acceptable. Do not support or fasten raceways to other pipe or in a manner to prevent the ready removal of other pipe.

2.08 GROUNDING

- A. Conform to NEC Article 250.
- B. Ground Wire: Color coded green, copper conductor, with insulation same as circuit or feeder conductors.
- C. Grounding Conductor: Provide green insulated equipment grounding conductor or circuit grounding conductor per NEC 250 in raceway system. Insulation and conductor type shall be the same as circuit conductors.

PART 3 – EXECUTION

3.01 RACEWAY

- A. IMC and EMT: Interior areas.
- B. RGS: Exterior area with approved weatherproof fittings.

- C. PVC: Exterior underground with RGS factory-radius elbows transitioning above ground.
- D. Flexible Conduit: Flexible metal conduit located in wet locations, mechanical room, kitchen areas, shall be liquid-tight type. A maximum of 72" of flexible metal conduit shall be used for the connection to motors and vibrating equipment, final connection to lay-in light fixtures. Flexible metal conduit shall be continuous grounding type and provide with grounding lug per spec. No flexible conduit allowed for any concealed installation.
- E. Minimum Sizes: Conduit sizes are not necessarily specified on Drawings. Provide a minimum 1/2" conduit branch circuits and minimum 3/4" conduit homeruns and multi-pole circuits. Refer to other specification sections for other minimum sizes. Contractor shall provide sizing of conduits as required to meet code where the above specified minimum sizes are too small to afford 40% fill. Conduit sizes shall be sized for conductor types and sizes per NEC.
- F. Conduit termination shall have code-sized junction box for flush or surface installation. Conduit stubs shall have nylon insulated type bushing.
- G. Pull Wires: Provide pull wires in all empty raceways. Pull wires shall be continuous in each raceway run and extend a minimum distance of 12" from the junction box or terminal at the end of the raceway.

3.02 INSTALLATION

- A. One-line diagrams, risers, and conduit routing are schematic and do not show exact arrangement of equipment.
- B. Where indicated on Drawings, junction boxes and pull boxes are minimum requirements. Provide other fittings and pull boxes of adequate size in the raceway system wherever necessary or required by the NEC. Allow a maximum of four 90-degree bends between pull boxes in each run of conduit.
- C. For root-top conduit installation, provide expansion joint fittings and Firestone rubber blocking (to match existing where applicable) and assemblies.
- D. Provide expansion joint fittings for conduits passing through new or existing expansion joints. Verify exact locations and details of expansion joints prior to work.
- E. Coordinate conduit routing, pull box and equipment locations with other trades to avoid conflicts of equipment installations. Empty conduits shall have pull wires.
- F. Conceal all raceways except as permitted by Architect.
- G. Where permitted, exposed raceway shall be run parallel or perpendicular to the building. Run raceways as high as possible, unless noted otherwise.

- H. Carefully form bends to avoid injuring or flattening raceway. Raceways 1-inch trade size and larger shall utilize factory formed fittings where bends are 45-degrees or larger. Minor offsets are permitted to be filed bent. All bends in conduits serving low-voltage systems shall not have bend radii less than 10-times the nominal conduit size.
- I. Support raceways with heavy-duty, one-hole, pressed steel straps on interior surfaces. Support pendant mounted raceways on 1/4" rod with pear-shaped hanger (up to 2" pipe size) or trapeze type hanger with 3/8" rod, 1-5/8" square preformed channel. Conduit support system shall be dedicated and isolated from other systems and ceiling supports or tees. Conduit installations shall not use ceiling type wire and clips as support system.
- J. Anchor all electrical work securely to structure using fasteners approved by a Washington State Licensed Structural Engineer for the types of structure encountered.
- K. Anchor to frame structure by means of sheet metal screws. Fasten to structural walls with lead anchors or steel expansion shells and threaded bolts or screws with slotted heads. Fasten to architectural or masonry walls with toggle bolts or molley screws. Deviation from these methods must be approved prior to installation.
- L. Furnish anchor bolts and anchorage items as required, and field check to insure proper alignment and location. Provide templates, layout drawings, and supervision at the job site to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- M. Control erection tolerance requirements to not impair the strength, safety, serviceability, or appearance of installations, as approved by the Engineer. Determine exact location of conduit. Route all conduit parallel to building lines.
- N. Hot-dip galvanize all exterior support hardware after fabrication.
- O. Install individual conductors in conduits, raceways, ducts, and trenches to complete the wiring systems.
- P. Install switches and cover plates complete in a neat manner in accordance with the NEC and local codes.

3.03 WIRE AND CABLE

- A. Branch circuits shall be #12 AWG minimum.
- B. Branch circuit wiring size #10 AWG and smaller shall have continuous color code identification per standard listed below. Tin all stripped ends of wiring #10 AWG and smaller prior to termination under set screws.

- C. Use no mechanical means for pulling wires, and no lubricant except powdered soapstone or approved substitute.
- D. Branch circuit splices may be made with 3M Scotch-Lok Electrical Spring type connectors up to #8 AWG size, except motor connections.
- E. Utilize crimp-type pressure connectors insulated with tape or pre-fabricated covers on motor connections and splices of wiring #6 AWG and larger.
- F. Make no splices in home runs.
- G. Do not inter-mix wiring from separate raceway systems unless specifically permitted by the Engineer.
- H. Color Coding Standards:

3Ø, 4 Wire System:	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

Control Wiring: Grey or black with identifying wire numbers at each termination

Color-coded Tape: May be used in lieu of color-coded insulation for conductors #8 AWG and larger. However, the insulation shall be black only and shall be tape-identified with color scheme shown above at splices, terminations and junction boxes.

- I. Each single pole branch circuit shall contain a dedicated neutral conductor and equipment grounding conductor of the same size as the hot conductors. Shared neutral conductors and/or multi-pole breakers used on single pole loads are not permitted.
- J. All wiring shall be identified with permanent wire labels, using alphanumeric designations. All terminations and splices shall be identically labeled for the same wire (i.e. common conductors terminated in multiple locations). Wire labels shall agree with the circuit designations on the as-built drawings. Provide Thomas and Betts, Brady, or equal, printed plastic adhesive tapes to show circuit numbers. Wrap tapes at least two turns around conductor.
- K. All conductors of a circuit, including the neutral and equipment grounding conductors must be installed together in the same raceway, cable, trench, cord, or cable tray, except as permitted by NEC Section 300.3 (B) (1) through (4)

- L. Identify conductors in outlets, pullboxes, and similar locations where conductors are accessible.
- M. Conductors in panels, cabinets, and enclosures: Provide neat and workmanlike installation with conductors tied with T&B Ty-Rap, or equal, nylon wire ties. Provide adhesive back nylon Ty-Rap 4-way bases (#TC200X200AX or equal) to group conductors in neat and orderly manner.
- N. Low voltage wiring and cables specified herein by Divisions 26, 27, or 28 shall be installed either in complete raceway system or shall be plenum rated.

3.04 WIRING DEVICES

- A. Installation: Install two or more wiring devices shown in one location under a common plate. Install plates with edges in continuous contact with finished wall surfaces. Do not install more than one device in single-gang position.
- B. Device Locations: Device or equipment mounting height given herein the Specifications, Contract Drawings, and/or documents are intended to provide general guidelines. Provide pre rough-in coordination and verification with other divisions. Verify that the intended mounting heights are appropriate for the intended device use, and the device location is not in conflict with other components.
- C. Prior to rough-in, devices and equipment locations may be revised by the Owner's Representative within 20' of the designed contract location, at no cost. Prior to rough-in, confirm locations with Owner for devices they may wish to have relocated from the location indicated on the contract drawings.
- D. If the contractor fails to provide such coordination and field verification and results of erroneous installation, the contractor shall remedy such installation per Owner Representative's direction, at contractor's cost.
- E. Provide GFCI protection for receptacles requiring GFCI protection per NEC Article 511.
- F. Receptacles in Bathtub and Shower Space are not permitted to be installed within a zone measured 3ft horizontally and 8ft vertically from the top of the bathtub rim or shower stall threshold per NEC 406.9.
- G. Mount wiring devices above finished floor to centerline of device as follows, unless noted otherwise or as directed by Owner's Representative. Coordinate with Owner's Representative for possible interference with decorative features, art displays, etc.

Switches	42-inches
Receptacles, Telecom Outlets	18-inches
Receptacles Above Counter	6-inches to CL above backsplash or as directed
Fire Alarm Pull Stations, Wall Phones	42-inches
Fire Alarm Audio Visual Devices	80-inches (or 6" below ceiling), whichever is lower
Receptacles (in Classified Areas)	24-inches (above finished floor and below ceiling)

3.05 BOXES

- A. Support boxes securely and independently.
- B. Mount boxes on building surfaces or support with trapeze hanger.
- C. Do not use junction boxes unless the number of bends, pulling length or circuit requirement necessitates their installation.
- D. Junction or pull box openings must be accessible.
- E. Do not use extension rings to provide Code size space within a new junction box. Provide larger junction boxes as required in lieu of extension rings.
- F. Do not intermix raceways and wiring at common junction boxes except at terminal equipment connections.

3.06 GROUNDING

- A. General: Provide system and equipment grounding in accordance with the applicable codes and ordinances and as further amplified on the Drawings.
- B. Ground service equipment, separately derived systems, conduits, devices and equipment in accordance with NEC, Article 250.
- C. Grounding Conductor: Provide green insulated equipment grounding conductor in conduits containing wiring systems above 50 volts. Insulation and conductor type shall be the same for circuit or feeder conductors. Size conductors in accordance with NEC Article 250.
- D. Bonding: All conduit systems shall be effectively grounded and bonded together by approved bonding means in accordance with the NEC. Verify ground continuity between conduits, boxes, receptacles, and equipment.

- E. Inspection: Place no backfill around grounding system until it has been inspected by the Engineer, Electrical Inspector, and Owner's Representative.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, and Division 27.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 2000 V or less.
 - 2. Aluminum building wire rated 600 V or less.
 - 3. Metal-clad cable, Type MC, rated 2000 V or less.
 - 4. Armored cable, Type AC, rated 600 V or less.
 - 5. Photovoltaic cable, Type PV, rated 2000 V or less.
 - 6. Mineral-insulated cable, Type MI, rated 600 V or less.
 - 7. Tray cable, Type TC, rated 2000 V or less.
 - 8. Fire-alarm wire and cable.
 - 9. Connectors, splices, and terminations rated 2000 V and less.
- B. Related Requirements:
 - 1. Section 26 05 13 "Medium-Voltage Cables" for single-conductor and multi-conductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 Volts.
 - 2. Section 26 05 23 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
 - 3. Section 27 13 13 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
 - 4. Section 27 15 13 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.03 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Data: For solvents and adhesives, indicating VOC content.
 - 3. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.
- C. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATION SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 – PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V or less.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Service Wire Co. or a comparable product by one of the following:
 - 1. Alpha Wire Company.
 - 2. American Bare Conductor.
 - 3. Belden Inc.
 - 4. Cerro Wire LLC.
 - 5. Encore Wire Corporation.
 - 6. General Cable Technologies Corporation.
 - 7. Okonite Company.
 - 8. Southwire Company.
 - 9. WESCO.
- C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide".
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
 2. Type RHH and Type RHW-2: Comply with UL 44.
 3. Type USE-2 and Type SE: Comply with UL 854.
 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 5. Type THHN and Type THWN-2: Comply with UL 83.
 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 7. Type UF: Comply with UL 83 and UL 493.
 8. Type XHHW-2: Comply with UL 44 and dual rated for 600 volt and 1,000 volt.

2.02 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Service Wire Co. or a comparable product by one of the following:
1. Alpha Wire Company.
 2. American Bare Conductor.
 3. Belden Inc.
 4. Cerro Wire LLC.
 5. Encore Wire Corporation.
 6. General Cable Technologies Corporation.
 7. Okonite Company.
 8. Southwire Company.
 9. WESCO.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide".
- D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

- E. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type RHH and Type RHW-2: Comply with UL 44.
 - 3. Type USE-2 and Type SE: Comply with UL 854.
 - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 5. Type THHN and Type THWN-2: Comply with UL 83.
 - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 7. Type XHHW-2: Comply with UL 44.

2.03 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. Basis-of-Design Product: Subject to compliance requirements, provide Service Wire Co. or a comparable product by one of the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems; a part of Atkore International.
 - 3. Gardner Bender.
 - 4. Hubbell Power Systems, Inc.
 - 5. Ideal Industries, Inc.
 - 6. ILSCO.
 - 7. NSi Industries LLC.
 - 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 9. TE Connectivity Ltd.
 - 10. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 – EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper solid for No. 16 AWG and smaller, stranded for No. 14 AWG and larger.

- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. VFC Output Circuits Cable: Flexible stranded for all sizes.
- E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
- F. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2 single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.

- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.
- N. PV Circuits: Type PV for PV source circuits rated at 1000 V.

3.03 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 26 05 33 "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 26 05 29 "Hangers and Supports for Electrical Systems".
- G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written requirements. Provide documentation of the torque connections to engineer for closeout documentation. If values do not match manufacturer recommendation, contractor to provide additional torqueing and provide documentation that the requirements have been adhered to. 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.
- D. Comply with requirements in Section 28 31 00 "Fire Detection and Alarm" for connecting, terminating, and identifying wires and cables.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "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.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve-seals at penetrations of exterior floor and wall assemblies.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping".

3.08 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. Perform tests and inspections with the assistance of a factory-authorized service representative.
 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 2. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding any critical equipment as deemed critical by the Owner's Representative.
 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductors and cables for physical damage and correct connections according to the single-line diagram.

- b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and identification.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to a portable scanner. Correct deficiencies determined during scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record of device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
 - 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Provide a complete grounding system that complies with the current edition of the National Electrical Code (NEC), and all applicable regulatory codes.
- B. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Metal underground water pipes.
 - 2. Metal frame of buildings.
 - 3. Rod electrodes.
 - 4. Building ground rings.
 - 5. Ground bars.
 - 6. Additional grounding and bonding components required.
 - 7. Ground rod access (test) wells.
- C. Performance Requirements: Maximum 5-ohms grounding system resistance.

1.03 REFERENCES

- A. NFPA 70 – National Electrical Code (NEC); National Fire Protection Association; Most recent edition adopted by the Authority Having Jurisdiction, including all applicable amendments and supplements.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturers catalog cuts for grounding electrodes, conductors, and connections.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of the Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Cooper Power Systems.
- B. Storm Copper Components Co.
- C. Harger.
- D. Or other reviewed and approved Manufacturers.

2.02 GROUND RODS

- A. Minimum size: 5/8" diameter by 8'-0" long, copper clad steel rods.

2.03 GROUND ROD TEST WELLS

- A. Minimum size: 12" diameter by 24" long, schedule 40 PVC with belled hub.
- B. Cover type: Flat steel with identification nameplate "GROUND TEST WELL".

2.04 GROUND BARS

- A. Copper bar with pre-punched holes.
- B. UL recognized standoff insulators for wall mounting.
- C. Stainless steel mounting brackets, stainless steel assembly bolts and lock washers.
- D. Suitable for indoor and outdoor installations.
- E. Size as required.

2.05 GROUND CONDUCTORS

- A. Grounding conductors shall be soft drawn, bare, stranded copper unless otherwise noted. Size as shown on the plans and per NEC, Article 250.
 - 1. Grounding Electrode Conductors for AC Systems:
 - a. See NEC Table 250.66.
 - 2. Equipment Grounding Conductors:

- a. See NEC Table 250.122.
- b. Equipment grounding conductors may be insulated; provide green insulation and/or approved permanent identification for conductors larger than #6 AWG.

2.06 GROUND ELECTRODE CONNECTORS

- A. Connectors for grounding electrode conductor to ground rod shall be of thermal fusion type; conductor-to-conductor connections may be either thermal fusion or approved hydraulically applied compression type.

2.07 GROUNDING BUSHINGS

- A. Grounding bushings shall be matched to the ampacity of the grounding conductor and shall have approved set-screw type grounding lug connectors.

2.08 GROUNDING CONNECTORS

- A. Shall meet the requirements of ground bushings, cast, set-screw, or bolted type.
- B. Clamps shall be matched to the ampacity of the grounding conductor. Provide approved raceway hub where grounding conductor is shown protected by conduit or armored cable. Clamps shall be U-bolt type for connection to water pipes.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that final backfill and compaction has been completed before driving rod electrodes.
- C. Prior to making mechanical or thermal connections, all conductors shall be clean, dry and bright with the bonding surface thoroughly cleaned of any oxides, mill, scale, or other foreign matter.

3.02 INSTALLATION

- A. Provide system and equipment grounding in accordance with the applicable codes and ordinances and as indicated on the Plans.
- B. Ground service equipment, separately derived systems, conduits, devices, and equipment in accordance with NEC, Article 250.
- C. Grounding Conductor: Provide green insulated equipment grounding conductor in conduits containing wiring systems above 50V. Insulation and conductor type shall be the same for circuit or feeder conductors. Size conductors in accordance with NEC Article 250.

- D. Inspection: Place no backfill around made electrode earth grounding systems until the installation is inspected and approved by the Owner's Representative and Electrical Inspector.
- E. Bonding: Conduit systems shall be effectively grounded and bonded together by approved bonding means in accordance with the NEC. Verify ground continuity between conduits, boxes, receptacles, and equipment.
- F. Install ground electrodes at locations indicated on Plans or required by NEC.
 - 1. Unless otherwise indicated, top of electrode shall be 6" below finished surface.
 - 2. Bury electrode conductors below finished surface.
- G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- H. Provide bonding to meet requirements described in Section 1 of this Specification.

3.03 GROUND CONTINUITY

- A. Maintain ground continuity throughout the entire electrical system.
- B. Permanently connect the electrical system neutral to the water service. The system shall be grounded only at transformer secondaries and at the main switchboard. Branch panel neutrals must be isolated from additional points of grounding.
- C. Provide approved grounding bushings or locknuts on all conduits terminating in panelboards, pullboxes, or other enclosures to insure continuity of conduit grounding connections.
- D. Securely ground lighting fixtures via the conduit system or by a separate suitable grounding conductor where flexible conduit is used.
- E. Provide a separate grounding conductor in all non-metallic conduits and in all flexible metallic conduit runs. Connect to the grounding system in an approved manner.
- F. Cable trays used as equipment grounding conductors shall be specifically approved for that purpose. Special bolted mechanical connectors and/or bonding jumpers shall be utilized to ensure system ground continuity.
- G. All plug-in receptacles shall be bonded to the box and raceway ground system unless specific isolated ground connections are shown on the Drawings.

3.04 GROUND CONNECTIONS

- A. All grounding connections shall be carefully made to insure low system impedance. Locate grounding connections to allow future servicing and expansion.

3.05 PROTECTION

- A. Ground conductors shall be protected from mechanical injury during construction. Provide protective coverings or rigid non-ferrous conduit.

3.06 GROUND RODS

- A. Ground rods shall be driven into undisturbed soil to full depth. Provide additional rods, ionic salt solutions and the like where special low-resistant grounds are specified.

3.07 THROUGH-SLAB GROUND PENETRATIONS

- A. Ground conductors extending through the slab shall be protected by a rigid conduit sleeve; the void portion of the sleeve shall be packed with a non-hardening type duct seal.

3.08 HIGH VOLTAGE CABLE GROUNDS

- A. Metallic shielding components, such as tapes, wires or braids, and their associated conducting or semi-conducting components shall be grounded per NEC Article 250. Ground terminations shall be made according to the manufacturer's written specifications.

3.09 TESTING

- A. Measure the Ohmic value of the electrical service entrance metallic "Electrical System Ground" with reference to "Earth Ground" using the "Multiple Ground Rods" method and suitable instruments. Maximum resistance to ground shall be less than 5 ohms. If this resistance cannot be obtained, notify the Owner's Representative in writing.
- B. Provide a paper copy of the test results and in the record O&M Manuals.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Aluminum slotted support systems.
 - 3. Nonmetallic slotted support systems.
 - 4. Conduit and cable support devices.
 - 5. Support for conductors in vertical conduit.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 8. Fabricated metal equipment support assemblies.
- B. Related Requirements:
 - 1. Section 26 05 48 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.03 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 the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.

2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
 1. Hangers. Include product data for components.
 2. Slotted support systems.
 3. Equipment supports.
 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
 1. Include design calculations and details of hangers.
 2. Include design calculations for seismic restraints.

1.04 INFORMATION SUBMITTALS

- A. Coordination Drawings. Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M.
 2. AWS D1.2/D1.2M.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 “Quality Requirements”, to design hanger and support system.
- B. Seismic Performance for Electrical Component Supports located within structures falling under seismic design categories C, D, E, and F: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term “withstand” means “the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event”.
 - 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at maximum of 8 inches o.c. in at least one surface.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc., pipe support and hanging systems, or comparable 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. GS Metals Corp.
 - f. G-Strut.
 - g. Haydon Corporation.
 - h. Metal Ties Innovation.
 - i. Thomas & Betts Corporation; A Member of the ABB Group.
 - j. Unistrut; Part of Atkore International
 - k. Wesanco, Inc.
 - 2. Pipe Bracket Kit Description: Pipe Bracket (PB1FT / PB2FT / PB3FT / PB4FT) and Universal (GC2-T) clamps or Compact (GC2-C) clamps. Manually assembled in the field to support multiple parallel pipes.
 - 3. Approvals: ISO 17025, MSS-SP 58, IAPMO/ANSI UPC 1-2012, UL 2239, and UL 2043.
 - 4. Material for Channel: Pregalvanized steel G90 (Z275).

5. Channel Width: Selected for applicable load criteria. Default is 1-3/4 inches.
 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Industries, Inc.
 - b. Flex-Strut Inc.
 - c. Haydon Corporation
 - d. MKT Metal Manufacturing
 - e. Thomas & Betts Corporation; A Member of the ABB Group.
 - f. Unistrut; Part of Atkore International.
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Material: 6063-T5 aluminum alloy.
 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 5. Channel Width: selected for applicable load criteria. Defaults are: 1-5/8 inches or 1-1/4 inches.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Steel and malleable iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; adjustable clamp and pipe bracket system for suspension of conduits 4-inch and smaller, or comparable products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton Business.
 - c. Fabco Plastics Wholesale Limited.
 - d. G-Strut.
 - e. Haydon Corporation.
 - f. Seasafe, Inc.; AMICO, a Gibraltar Industries Company.
 2. Wire Rope Type 1: High tensile steel wire rope, to ASTM A1023/1023M, class A zinc coating; 7 by 7 and 7 by 19 cross-sectional construction; having a tensile strength of 256,000 psi; lengths, diameters, and wire construction as indicated on Shop Drawings. Cables are pre-cut lengths

- with fused ends. Pre-made end attachments are available depending on the application.
3. Wire Rope Type 2: High tensile steel wire rope, to ASTM A492, Type 316 stainless steel, 7 by 7 cross-sectional construction; having a tensile strength of 256,000 psi; lengths, diameters, and wire construction as indicated on Shop Drawings. Cables are pre-cut lengths with fused ends. Pre-made end attachments are available depending on the application.
 4. Y-Fit: Two wire ropes, arranged to form two leg attachment points at one end with a ferrule. Factory-crimped with a 30-ton hydraulic press. For loads up to 200 lbs (5:1 safety factor).
 5. Adjustable Fastener Type 1: One-piece die cast type ZA2 zinc two-channel housing; encasing a series of Type 302 stainless-steel springs with serrated self-locking steel wedges, adjustable with setting key or integrated mechanism; UV stabilized homopolymer polypropylene end caps. Sizes as indicated on Shop Drawings. Safe working load (SWL) with 5:1 safety factor. Gripple model HF/XP Adjustable Fastener.
 6. Adjustable Fastener Type 2: One-piece Type 316 stainless-steel two channel housing to ASTM A167; encasing a series of Type 302 stainless-steel springs with serrated self-locking ceramic wedges, adjustable with setting key; Type 316 A4 stainless-steel end caps. For load of 200 lb or 500 lb. SWL with 5:1 safety factor. Model: Gripple No. 3 or 4 Stainless Steel Adjustable Fastener.
 7. Adjustable Fastener Type 3: One-piece die cast type ZA2 zinc one-channel housing; encasing a series of Type 302 stainless-steel springs with serrated self-locking ceramic wedge adjustable with setting key; Type 316 A4 stainless-steel end caps. For load of 200 lb or 500 lb. SWL with 5:1 safety factor. Model: Gripple No. 3 or 4 Stainless Steel Adjustable Fastener.
 8. Adjustable Fastener Type 4: One-piece die cast type ZA2 zinc one-channel housing; encasing a series of Type 302 stainless-steel springs with serrated self-locking steel wedge, adjustable with integrated mechanism; UV stabilized homopolymer polypropylene end caps. Sizes as indicated on Shop Drawings. SWL with 5:1 safety factor. Gripple model STZ2/TZ3 Adjustable Fastener.
 9. Adjustable Fastener Type 5: Mild steel (type EN1A), bright zinc plated, one-channel body; encasing a series of Type 302 stainless-steel springs with serrated self-locking grade 40 chrome steel balls, adjustable by means of an integrated mechanism, capable of accommodating load of 100 lb, 200 lb, or 500 lb as required. Model No. 2, 3, or 4 Trapeze Plus Adjustable Fastener.
 10. Adjustable Fastener Type 6: One-piece die cast type ZA2 zinc two-channel housing; encasing a series of Type 302 stainless-steel springs with serrated self-locking ceramic rollers, adjustable with setting key and extra allen key locking mechanism; UV stabilized homopolymer polypropylene end caps. UL/CSA listed. Manufactured in an ISO 9002 facility. Sizes as indicated on Shop Drawings. SWL with 5:1 safety factor. Gripple Lockable Plus Adjustable Fastener.
 11. Adjustable Fastener Type 7: Bright nickel-plated, type ZA2 zinc housing; encasing a Delrin 511P NC010 spring with self-locking brass roller,

- adjustable with integrated mechanism. For loads up to 30 lb. SWL with 5:1 safety factor. Model: Gripple Angle Hanger Family
12. End Fixing Type 1: Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit (loop, stud, toggle, hook, 90-degree eyelet, or shot fire).
 13. End Fixing Type 2 (C-Clip): Zinc ZA2 for load of 100 lb (Gripple No. 2). C-Clip: 1/8 inch or 1/4 inch with crimped loop fastener. Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 14. End Fixing Type 2 (Shot Fire Ceiling Clip and Pin): Galvanized steel pin and clip for load of 25 lb (Gripple No. 1) or 100 lb (Gripple No. 2). Shot Fire: C925 with crimped loop fastener. Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 15. End Fixing Type 3 (Eyelag): Galvanized steel eyelag screw for load of 25 lb (Gripple No. 1) or 100 lb (Gripple No. 2). Eyelag: ELD with crimped loop fastener. Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 16. End Fixing Type 4 (Swivel Toggle): Zinc-plated steel, 1-1/2 inches, for load of 100 lb (Gripple No. 2) or 200 lb (Gripple No. 3). Swivel Toggle: Gripple Spider/MDI. Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 17. End Fixing Type 5 (Loop Ferrule): Type 316 stainless-steel, ASTM A167, 1/2 inch by 5/16 inch, for load of 100 lb (Gripple No. 2) or 200 lb (Gripple No. 3). Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 18. End Fixing Type 6 (Toggle Plate and Endstop): Type 304/A2 stainless-steel, 1/4 inch thickness, 5/16 inch by 1-9/16 inch, for load of 100 lb (Gripple No. 2). Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 19. End Fixing Type 7 (Threaded Stud): Type 304/A2 stainless-steel, 1/4 – 20 (M6 x 1) threaded rod, for load of 100 lb (Gripple No. 2) or 200 lb (Gripple No. 3). Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 20. End Fixing Type 8 (Hook Stud): Type 304/A2 stainless-steel, 1/4 inch thickness, 5/8 inch by 3 inches, for load of 100 lb (Gripple No. 2). Mechanically-spliced wire rope with factory end fixing using a 30-ton hydraulic press; to accommodate the design load and safety factor of the fastener kit.
 21. End Fixing Type 9 (Barrel): Zinc-plated steel with aesthetic fixing for use with up to 1/4 inch or 3/8 inch threaded anchor, for load of 200 lb. SWL with 5:1 safety factor.

- D. Accessories:
1. Cable Basket Adaptor: Galvanized steel adaptor for load of 100 lb (Gripple No. 2), to suspend cable basket with wire diameter up to 1/4 inch.
 2. Y-Fit: Two wire ropes, arranged to form two leg attachment points at one end with a ferrule. Factory-crimped with a 30-ton hydraulic press. For loads of 50 lb (Gripple No. 1), 100 lb (Gripple No. 2) or 200 lb (Gripple No. 3).
 3. Karabiner: Galvanized steel karabiner for load of 200 lb with 5:1 safety factor, to suspend cable basket.
 4. G-Bracket: Cold formed mild steel bracket (BS EN 10346:2009 DX51D) with slots to support cable trays, for load up to 100 lb (SWL with 3:1 safety rating), compatible with Y-fit range.
 5. GF Bracket: Ductile iron with hot dip galvanized finish. Bracket for clamping onto wide flange beam section, suitable for 1/4 inch to 1/2 inch flange thickness, and for use with 1/2 inch diameter threaded rod supplied by others.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedge 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.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- G. 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. Mechanical-Expansion Anchors: Insert wedge type, zinc-coated or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line, an Eaton business.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

- 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 – EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101.
 3. NECA 102.
 4. NECA 105.
 5. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installations for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems".
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25-percent in the future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Section.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or spring-tension clamps.
 - 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.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10-bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033053 "Miscellaneous Cast-in-Place Concrete".
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 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.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" as required for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, and Division 27.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Floor boxes.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. EMT: Electrical metallic tubing.
- C. GRC: Galvanized rigid steel conduit.
- D. IMC: Intermediate metal conduit.

1.04 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.
- C. Samples: For wireways, nonmetallic wireways and surface raceways and for each color and texture specified, provide 12-inch long sample(s).

1.05 INFORMATION SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 – PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. FSR Inc.
 - 6. O-Z/Gedney; and EGS Electrical Group brand.
 - 7. Patriot Aluminum Products, LLC.

8. Picoma Industries.
 9. Republic Conduit.
 10. Robroy Industries.
 11. Southwire Company.
 12. Thomas & Betts Corporation, A Member of the ABB Group.
 13. Western Tube and Conduit Corporation.
 14. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
 3. 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.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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

1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.
 3. Arnco Corporation.
 4. CANTEX INC.
 5. CertainTeed Corporation.
 6. Condux International Inc.
 7. Electri-Flex Company.
 8. Kraloy.
 9. Lamson & Sessions.
 10. Niedax Inc.
 11. RACO; Hubbell.
 12. Thomas & Betts Corporation, A Member of the ABB Group.
- B. Listing and labeling: Nonmetallic conduits, tubings, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. Rigid HDPE: Comply with UL 651A.
- G. Continuous HDPE: Comply with UL 651B.
- H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- I. RTRC: Comply with UL 1684A and NEMA TC 14.
- J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- K. Fittings for LFNC: Comply with UL 514B.
- L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- M. Solvent cements and adhesive primers shall comply with the testing and product requirements as required for approval from the AHJ.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.

2. Hoffman; a brand of Pentair Equipment Protection.
 3. MonoSystems, Inc.
 4. Square D.
 5. Wiegmann; division of Hubbell Incorporated.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be NEMA-3R and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged Type, unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Moulded Products, Inc.
 2. Hoffman; a brand of Pentair Equipment Protection.
 3. Lamson & Sessions.
 4. Niedax Inc.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Coupling, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for a complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- G. Solvent cements and adhesive primers shall comply with testing and product requirements as required per AHJ.

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Incorporated; steel boxes or comparable product by one of the following:
1. Adalet.
 2. Cooper Technologies Company.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. FSR Inc.
 6. Hoffman; a brand of Pentair Equipment Protection.
 7. Kraloy.
 8. Milbank Manufacturing Co.
 9. MonoSystems, Inc.
 10. Oldcastle Enclosure Solutions.
 11. O-Z/Gedney; an EGS Electrical Group brand.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation, A Member of the ABB Group.
 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing up to 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous hinge cover with flush latch unless otherwise indicated. Enclosures outside or interior wet locations shall be NEMA Type 3R.
 - 1. Metal Enclosures: Steel finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic or fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. 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. Enclosures outside or interior wet locations shall be NEMA Type 3R.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 - f. Synertech Moulded Products.
 - 2. Standard: Comply with SCTE 77.
 - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molding lettering, "ELECTRIC" or "SYSTEMS".
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 inches wide by 24 inches long and larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass handholes and boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete or fiberglass.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Nordic Fiberglass, Inc.
 - e. Oldcastle Precast, Inc.
 - f. Quazite: Hubbell Power Systems, Inc.
 - g. Synertech Moulded Products
 2. Standard: Comply with SCTE 77.
 3. Color of Frame and Cover: Green.
 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having a structural load rating consistent with enclosure and handhole location.
 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction 0.50.
 7. Cover Legend: Molded lettering, "ELECTRIC" or "SYSTEMS".
 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 9. Handholes 12 inches wide by 24 inches long and larger. Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.07 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied:
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 – EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC. Concrete encased under roadways and streets, or areas subject to vehicular traffic.
 - 4. Connection to vibrating equipment (Including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment): LFMC.
 - 5. Boxes and enclosures, aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, not subject to physical damage: EMT.
 - 2. Exposed, not subject to severe physical damage: EMT.
 - 3. Exposed, and subject to severe physical damage: GRC. Raceway locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical Rooms.
 - d. Gymnasiums.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to vibrating equipment (Including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4 inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. 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.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this Section are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slabs.
- F. Install no more than the equivalent of four (4) 90-degree bends in any conduit run except for control wiring circuits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways embedded in slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings.
1. Use EMT for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. 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.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch trade size and insulated throat metal bushings on 1-1/2 inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. 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.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12-inches of slack at each end of pull wire. Cap underground raceways as designated as spare above grade alongside raceways in use.
- S. 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.

- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment, including light fixtures, subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- W. 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.
- X. 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.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. 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.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter

2. Install backfill as specified in Section 312000 "Earth Moving".
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving".
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems".

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size

holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.06 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping".

3.07 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

SECTION 26 05 4

UNDERGROUND ELECTRICAL CONSTRUCTION

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. This Section includes the requirements for trenching, backfilling, and installation of underground conduits, ducts, and ductbanks, and the design, fabrication, delivery and installation of pullboxes, handholes, vaults, and manholes.

1.03 RELATED SECTIONS

- A. Division 03 "Concrete".
- B. Division 31 "Earthwork".
- C. Division 26 Section "Grounding and Bonding".
- D. Division 26 Section "Hangers and Supports for Electrical Systems".
- E. Division 26 Section "Raceways and Boxes".
- F. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- G. Division 27 Section "Basic Materials and Methods for Communication Systems".

1.04 REFERENCES

- A. ASTM (American Society for Testing and Materials).
- B. NFPA 70 (National Fire Protection Association) – National Electrical Code.
- C. ANSI C2 "National Electrical Safety Code".

1.05 SUBMITTALS

- A. Submit under provisions of Division 01.

- B. Submit catalog cuts for all items proposed to be furnished and installed under this Section.
- C. Provide submittals which shall include the following:
 - 1. Provide product data for accessories for vaults and handholes, conduit, duct, ductbank materials, and miscellaneous components.
 - 2. Shop drawings showing details and design calculations for precast vaults and handholes, including reinforcing steel.
 - 3. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C 858.
 - 4. Inspection report for factory inspections, according to ASTM C 1037.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
- C. Provide products listed and classified by Underwriters Laboratories (UL) as suitable for the purpose specified and indicated.
- D. Conform to requirements of ANSI C2 "National Electrical Safety Code" for components and installation.

1.07 DEFINITIONS

- A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
- B. Ductbank: Two or more conduits or other raceway installed underground in the same trench or concrete envelope.
- C. Handhole: An underground junction box in a duct or ductbank.
- D. Vault: An underground utility structure, large enough for a person to enter, with facilities for installing, operating, and maintaining equipment and wiring.

1.08 COORDINATION

- A. Coordinate layout and installation of ducts, vaults, and handholes with final arrangement of other utilities as determined by field verification. Revise locations and elevations from those indicated as required to suit field conditions and ensure that duct runs drain to vaults and handholes.

1.09 SAFETY REQUIREMENTS

- A. Perform work in accordance with the safety requirements of the Department of Labor Occupational Safety and Health Administration, Volume 36, Number 75,

Part II, Subpart P, "Excavations, Trenching, and Shoring", and with Section 7 of the Manual of Accident Prevention in Construction as published by the Association of General Contractors of America, Inc.

- B. Educate supervisors and employees on safety requirements and practices to be followed during the course of the work.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to the site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store pre-cast concrete units at the site as recommended by the manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support pre-cast concrete units only at designated lifting or supporting points.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manholes, Vaults, and Handholes: Subject to compliance with requirements, provide products by one of the following:
 - 1. Utility Vault Company (OldCastle Precast).
 - 2. Jensen Precast.
 - 3. Hubbell Quazite.
 - 4. Or other reviewed and approved Manufacturers.

2.02 CONDUIT AND DUCTS

- A. Metallic Conduit: Rigid Galvanized Steel Conduit (RMC): ANSI C80.1.
- B. Non-Metallic Conduit:
 - 1. Rigid PVC Conduit: NEMA TC 2, UL 651A, Schedule 40 and Schedule 80 PVC, sunlight resistant, rated for use with 90 deg C conductors under all installation conditions and UL labeled for underground use, direct burial, or aboveground.

2.03 CONDUIT FITTINGS

- A. Steel Fittings: Zinc coated, cast malleable, ferrous metal, threaded fittings, with neoprene cover gasket on each fitting installed outdoors.
- B. PVC Conduit and Tubing Fittings: NEMA TC 3.
- C. "Mogul Fittings": Provide "Mogul" size fittings for all conduit.

- D. Seal Bushings: Compound filled bushing on each conduit entering a building from outside underground and on each conduit passing from one space into another, which is normally at a lower temperature.
- E. Hubs: Appleton "Hub", "Hub-U" Series, Thomas & Betts "370" Series, or approved equal hub on each conduit terminating in a box where a hub was not previously provided.
- F. Unions: Three piece threaded conduit unions where necessary.

2.04 DUCT SUPPORTS

- A. Rigid PVC spacers selected to provide 3-1/2 inch minimum duct spacing or as indicated on Drawings.

2.05 PULLBOXES

- A. Cast Metal Boxes: Cast aluminum, sized as indicated on drawings or per codes, with outside flanges and recessed, gasketed cover for flush mounting. Non-skid finish on cover with legend reading "ELECTRIC", "COMMUNICATIONS", or "SIGNAL" as appropriate. Provide traffic-rated, H20 minimum loading, in areas subject to vehicle traffic or access drives.

2.06 HANDHOLES

- A. General: Pre-cast concrete or structural plastic with the following standard features:
 - 1. Cover with insert or other device to facilitate lifting.
 - 2. Cover with locking devices similar to REA or FARGO.
 - 3. Drain hole in base, 2 inch minimum diameter.
 - 4. Knockouts in sides of adequate number and spacing to accommodate ductbank shown on Drawings.
- B. Exterior Lighting: Reinforced plastic mortar designed and tested to temperatures of -50 degrees F meeting ASTM D635-91 flammability test.
- C. Handhole Covers: Reinforced concrete, cast iron, or structural plastic, capable of supporting designed loads. Where located in roadways or traffic areas, covers shall be designed to support H20 minimum loading. Cast iron cover with cast-in-legend "ELECTRIC", "COMMUNICATIONS", or "SIGNAL" as appropriate. Machine cover-to-frame bearing surfaces.

2.07 ACCESSORIES

- A. Duct Supports: Rigid PVC spacers selected to provide 3-1/2 inch minimum duct spacings and concrete cover depths as indicated on the Drawings, while supporting ducts during concrete pour.
- B. Manhole/Vault Lifting Means:

1. Pulling Eyes in Walls: Eyebolt with reinforcing bar fastening insert. 2-inch diameter eye, 1 inch by 4 inch bolt. Working load with 6 inch embedment in 4000 psi concrete: 13,000 pounds minimum tension.
 2. Pulling and Lifting Irons in Floor: 7/8-inch diameter, hot dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular opening. Ultimate yield strength: 40,000 pounds shear and 60,000 pounds tension.
- C. Sump Frame and Grate: Comply with FS RR-F-621, Type-VII for frame and Type-I for cover.
- D. Bolting Inserts for Cable Racks: Flared, threaded inserts of non-corrosive, chemical resistant, non-conductive thermoplastic material 36-inches on center; 1/2-inch internal diameter by 2-3/4 inches deep, flared to 1-1/4 inch minimum at base. Tested ultimate pull-out strength: 12,000 pounds minimum.
- E. Expansion Anchors for Installation after Concrete is Cast: Zinc plated carbon steel wedge type with stainless steel expander clip, 1/2-inch bolt size, 5300-pound rated pull-out strength, and 6800-pound rated shear strength minimum.
- F. Cable Racks: Non-metallic cable rack stanchion, 36-inch high X 4-inch wide, yellow Glass Reinforced Polymer, elongated mounting holes.
- G. Cable Arms: Non-metallic cable rack arms. Size and weight capacity in accordance with manufacturer's load rating.
- H. Cable Support Insulators: High glaze, wet process porcelain arranged for mounting on cable arms.
- I. Ground Rods: Solid copper clad steel, 3/4-inch diameter by 10-feet length or as indicated on Drawings.
- J. Ground Wire: Stranded bare copper, #4/0 AWG minimum or as indicated on the Drawings.
- K. Duct Sealing Compound: Non-hardening, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35 deg F withstands temperature of 300 deg F without slump, and adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals.

2.08 BACKFILL MATERIAL

- A. Reinforced Concrete Ductbanks: Provide in accordance with Division 31 Section "Earthwork" in locations shown on Drawings:
1. Below Concrete Encasement: 6-inches minimum compacted 5/8-inch minus crushed rock.
 2. Above Concrete Encasement: 3-inch minimum sand.
 3. Upper Trench:

- a. Areas under Pavement: Controlled Density Fill:
 - 1) Content: A mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating and free flowing material which will result in a hardened, dense, non-settling and excavatable fill. Batch and mix in accordance with Division 03 to provide a flowing, non-segregating mix with a slump between 6-inch and 8-inch.
 - b. Areas not under Pavement: Select Native Fill:
 - 1) Unsaturated excavated earth free of rocks, broken concrete and debris 6-inch and larger, and compacted in 12-inch lifts to prevent settlement.
 - c. Provide Underground Warning Tape 3-inches (76 mm) wide polyethylene tape, detectable type colored red with suitable warning label describing buried electrical lines, buried 12-inches below grade.
- B. Direct Burial Conduit:
 - 1. Initial Bedding: 3-inches of sand below conduits.
 - 2. Secondary Bedding: Unsaturated excavated earth free of rocks, broken concrete, and debris 2-inches and larger, and compacted to 6-inch minimum above conduits.
 - 3. Upper Trench:
 - a. Areas under Pavement: Controlled Density Fill:
 - 1) Content: A mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating, and free flowing material which will result in a hardened, dense, non-settling and excavatable fill. Batch and mix in accordance with Division 03 to provide a flowing, non-segregating mix with a slump between 6-inch and 8-inch.
 - b. Areas not under Pavement: Select Native Fill:
 - 1) Unsaturated excavated earth free of rocks, broken concrete, and debris 6-inch and larger, and compacted in 12-inch lifts to prevent settlement.
 - c. Provide Underground Warning Tape 3-inches (76 mm) wide polyethylene tape, detectable type colored red with suitable warning label describing buried electrical lines, buried 12-inches below grade.
- C. Material:
 - 1. Gravel: 3/8-inch maximum.
 - 2. Slump: 4-inch maximum.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine site to receive ducts and vaults for compliance with installation tolerances and other conditions affecting performance of the underground ducts and vaults. Do not proceed with installation until unsatisfactory conditions have been corrected and installations have been inspected by WA State Labor & Industries (LNI) Inspectors.
- B. Existing Utilities: Locate all existing utilities in the area prior to performing any trenching or excavation work. Coordinate with Civil.

3.02 EARTHWORK

- A. Comply with Division 31, Earthwork.
- B. Trenching:
 - 1. Comply with OSHA/WISHA safety standards for trenching, including stable slope and shoring requirements.
 - 2. Depth: Refer to drawings for trench depth requirements. Correct points of over-excavation using mechanically compacted backfill to form a smooth trench bottom.
 - 3. Width: Excavate to minimum width consistent with stability of sides.
 - 4. Slope: Slope trenches so that conduit and ducts drain toward vaults and handholes and away from buildings and equipment.
 - 5. Muck Excavation: Where much or unstable material is encountered, over excavate and backfill to attain proper grade with coarse sand, gravel, or controlled density fill.
 - 6. Pile backfill material in an orderly manner; a sufficient distance from the trench to avoid overloading trench banks.
 - 7. Bedding: The entire bottom of the excavation is to be firm, stable, and at uniform density.
- C. Excavating for Handholes and Vaults: Provide 12-inch minimum clearance between outer surfaces of unit and embankment or timber used for shoring.

3.03 BACKFILLING

- A. See Division 31, Section "Earthwork".

3.04 RACEWAY APPLICATIONS

- A. Refer to Specifications and Drawings for raceway materials.
- B. Metallic Conduit: Only use as specified in Division 26, Section "Raceways and Boxes".
- C. Non-Metallic Conduit: Use underground only:

1. Underground in Reinforced, Concrete Encased Ductbanks: Use Schedule 80 Rigid Plastic Conduit as standard (except rigid steel under roadways). Use rigid steel on bends 45 degrees or greater. Use of Schedule 40 PVC Conduit under non-traffic areas is acceptable.
2. Underground Direct Burial: For low voltage applications only where identified on Contract Drawings. Use in reinforced, concrete encased ductbanks: Use Schedule 80 Rigid Plastic Conduit as standard (except rigid steel under roadways). Use rigid steel on bends 45 degrees or greater. Use of Schedule 40 PVC Conduit under non-traffic areas is acceptable.
3. All underground conduit shall be a minimum of 2-inch standard trade size, except as permissible to use 1-inch for exterior lighting, control, etc. as shown in Drawings.
4. Use PVC fittings for PVC conduit and suitable watertight connections where PVC conduit connects to galvanized steel conduit.
5. Galvanized rigid steel conduit installations underground or under concrete slab shall be factory coated with 3-mil bitumastic or protected with 3M Scotchrap pipe primer and Scotchrap 50 (10-mil) spirally applied half-lapped tape.

3.05 CONDUIT INSTALLATION

- A. Install conduit and as indicated on Drawings and according to manufacturer's written instructions.
- B. Curves and Bends: Use manufactured galvanized rigid steel elbows for stub-ups at equipment and at building entrances with a minimum radius of 36-inches. Use long sweep bends with a minimum radius of 25-feet both horizontally and vertically at other locations, not to exceed 20 degrees for field bends or as indicated on the Drawings.
- C. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Vaults and Handholes: Space end bells approximately 8-inches on center for 4-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end bell spacing 10-feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into vault walls from both sides to provide watertight entrances.
- E. Building Entrances: Transition from underground duct to rigid steel conduit 5-feet minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below:
 1. Direct Buried, Non-encased Duct entering non-waterproofed walls: provide a Schedule 40 galvanized steel pipe sleeve for each duct. Caulk space between the conduit and sleeve with duct sealing compound on both sides for moisture-tight seal.

2. Waterproofed Wall and Floor Entrances: provide a watertight entrance sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight. Manufactured by OZ/Gedney or approved equal.
- F. Separation between direct buried, non-encased ducts: Provide 3-inches minimum separation for like services, and 12-inches minimum between power and communication/signal ducts.
- G. Concrete Encased Non-Metallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts at 8-feet maximum, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 2. Minimum Clearances Between Ducts: 3-inches between ducts and exterior envelope wall, 3-inches between ducts for like services, and 12-inches between power and communication/signal ducts, or as indicated on the Drawings.
 3. Depth: Install top of ductbank at least 18-inches below finished grade in non-traffic areas and at least 24-inches below finished grade in vehicular traffic areas.
- H. Stub-Ups: Use rigid steel conduit for stub-ups through concrete to equipment. Install insulated grounding bushings at the conduit terminations. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 4-inches beyond the edge of the pad. Couple steel conduits to the ducts with adapters designed for the purpose and then encase the coupling with 3-inches of concrete.
- I. Sealing: Provide temporary closure at all duct terminations in vaults installed on this Project. Use sealing compound and plugs to withstand a minimum of 15 psi hydrostatic pressure.
- J. Pulling Wire: Install 100-pound test nylon cord in installed ducts, including spares, or pull rope as indicated on the Drawings.

3.06 VAULTS, AND HANDHOLES INSTALLATION

- A. Install as indicated on Drawings according to manufacturer's written instructions, ASTM C 891, and Divisions 03 and 31:
1. Install units plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.
 2. Support units on a level bed of crushed stone or gravel, graded from the 1-inch sieve to the No. 4 sieve and compacted to the same density as the adjacent undisturbed earth.

3. Drainage: Where vaults have drain holes in the bottom, provide 2-feet minimum of gravel below the drain hole or provide a drain line to the nearest storm drain.
- B. Grounding: Install grounding as indicated on Drawings and/or Section 26 05 26 "Grounding and Bonding".
- C. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cable and conductors and as indicated on Drawings:
 1. Field Installed Bolting Anchors: Do not drill deeper and 3-7/8 inches for field-installed anchor bolts. Use a minimum of (2) anchors for each cable stanchion.
- D. Train cables neatly around corners and secure to walls or ceiling using cable clamps with expansion anchors.

3.07 UNDERGROUND WARNING TAPE

- A. Warning tape shall be installed directly above the pipe or concrete for encased ducts, at a depth of 12-inches below finished grade unless otherwise shown.

3.08 PERMANENT MARKERS

- A. Where ducts (conduits) are stubbed below grade for future services, provide graystone Index PC 3.06 Surveyor's Monument located directly over end of stubbed duct with top at finished grade, with marking indicating system piping serves.

3.09 IDENTIFICATION

- A. Identify raceways, cables, and equipment as specified in Section 26 05 53 "Identification for Electrical Systems", or as indicated on Drawings.
- B. Provide warning and caution signs as required by the Authority Having Jurisdiction, these Specifications, or as indicated on Drawings.
- C. Label raceways entering concealed locations from exposed locations as to the destination via the concealed area.

3.10 TESTING AND CLEANING

- A. Verify that vaults and handholes are essentially dry. In the case where the presence of water will prevent the continuation of work, pump the vault or handhole dry and seal obvious leak points with epoxy grout or polyurethane-based water sealant. For plugging conduits use a plug capable of 15 psi hydrostatic pressure. Coordinate pumping discharge with the Engineer and obtain the approval from the Owner.

- B. Pull brush through full length of ducts. Use round bristle brush with a diameter of 1/2-inch greater than internal diameter of duct. Clean internal surfaces of vaults and handholes, including sump.
- C. Duct Integrity: Swab out ducts with a mandrel 1/4-inch smaller in diameter than internal diameter of ducts. An Owner's Representative shall be present to witness all mandrel pulls.
- D. Grounding: Test vault grounding to ensure electrical continuity of bonding and grounding connections in accordance with Section 26 05 26 "Grounding and Bonding". Measure ground resistance at each ground rod and report in final test results per Section 26 08 00 "Electrical Acceptance Testing". Use an instrument specifically designed for ground resistance measurements.
- E. Written certification by electrical contractor that all testing and cleaning has been tested and cleaned per Specifications. Provide written certification that vaults are grounded and meet or exceed the requirements of this section. Provide written certification as to testing and testing results to Engineer, Commissioning Authority, and included in O&M Manual.

END OF SECTION

SECTION 26 05 48

SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Restraint channel bracings.
 - 2. Restraint cables and accessories.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.
- B. Related Requirements:
 - 1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic restraint component used
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For each seismic-restraint device.
 - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to

- select seismic and wind restraints and for designing vibration isolation bases.
- a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- 3. Seismic and Wind Restraint Details.
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restrain and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation. By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.04 INFORMATION SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical Components include:
 - 1. Control and Monitoring Panels.
 - 2. Generators.
 - 3. Luminaires.
 - 4. Motor Control Centers.
 - 5. Panelboards.
 - 6. Photovoltaic System Components.
 - 7. Substations.
 - 8. Switchboards.
 - 9. Switchgear.
 - 10. Transformers.
 - 11. Unit Substations.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel".
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 – PRODUCTS

2.02 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 30mph.
 - 2. Building Classification Category: I, II, III, or IV as required per Architect.
 - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: A, B, C, D, E, or F as required per Architect.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I, II, or III as required per Architect.
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5.
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 seconds): percentage as required per Architect.
 - 4. Design Spectral Response Acceleration at 1.0 Second Period: percentage as required per Architect.

2.03 RESTRAINT CHANNEL BRACINGS

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

1. B-line, an Eaton Business.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Part of Atkore International.

- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.04 RESTRAINT CABLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; GS Seismic Bracing Kits, or a comparable product by one of the following:
1. Kinetics Noise Control, Inc.
 2. Vibration & Seismic Technologies, LLC.
 3. Vibration Mounting & Controls, Inc.
- B. Restraint Cables: ASTM A 1023 galvanized-steel cables. End connections made of steel assemblies with adjustable seismic fastener, thimbles, brackets, swivel, and bolts designed for restraining cable service; with loop ferrule to accommodate the load and safety factor of the fastener kit or a minimum of two clamping bolts for cable management.
- C. Adjustable Seismic Fastener: One-piece die cast type ZA2 zinc two-channel housing; encasing a series of Type 302 stainless-steel springs with serrated self-locking steel wedges, adjustable with setting key; ZA2 zinc end caps with locking screws.

2.05 SEISMIC-RESTRAINT ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; Rod Stiffener (RS) or comparable product by one of the following:
1. B-line, an Eaton Business.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support system sleeve with internally bolted connections to hanger rod.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

- D. Bushing Assemblies for Wall-Mounted Equipment and Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.06 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton Business.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
 - 5. Powers Fasteners.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.07 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. Powers Fasteners.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete" and Section 033053 "Miscellaneous Cast-in-Place Concrete".
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords or bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven (7) day's advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four (4) of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. Provide completely identified electrical systems and equipment that complies with the current edition of the National Electrical Code (NEC), and all applicable regulatory codes.

1.03 CALCULATIONS AND LABELLING

- A. Provide complete Arc-Flash Hazards Calculation Report and label all equipment required per NFPA 70E to properly identify arc-flash hazards. Contractor is required to pay for and submit Arc-Flash Hazards Calculation to Owner's Representative and Engineer for review and approval prior to commencing work.
- B. Provide complete Overcurrent Protective Device Coordination Study Report and install all devices per settings contained in Coordination Study Report. Contractor is required to pay for and submit Coordination Study Report to Owner's Representative and Engineer for review and approval prior to commencing work.

1.04 LABELLING GENERAL

- A. Label each and every circuit breaker in the Main Switchboard(s) or Distribution Board(s) with a phenolic nameplate that identifies the load and location served.
- B. Label all panelboards with a phenolic nameplate that also identifies the voltage, ampere rating, and source panel.
- C. Provide a sign on the cover of each panelboard requiring a minimum of 36" or 42" of clear working space in front of the panel.
- D. Label all transformers with a phenolic nameplate that identifies the source panel and the panel or load being served.

- E. Label all disconnect switches and motor starters and permanently mounted electrical loads and control equipment with a phenolic nameplate that identifies the source panel, circuit number, and the load served.

1.05 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.
- B. NFPA 70E – Standard for Electrical Safety in the Workplace.
- C. ASTM International.

1.06 GENERAL REQUIREMENTS

- A. Electrical and Communications Vaults shall be properly labeled per ID shown on the Drawings.
- B. Underground conduits shall be properly labeled in vaults and in buildings where conduits stub up from below grade. Contractor shall be responsible for the ID names/numbers.
- C. Electrical and Low-Voltage Equipment shall have placards with appropriate ID on front covers of equipment.
- D. All interior conduit and junction boxes shall be labelled with panel name and circuit numbers of conductors routed via conduit and junction boxes.
- E. Conductors shall be properly identified with both color coding and self-adhesive labels.
- F. All equipment per NFPA 70E that requires arc-flash labelling shall be properly identified per NFPA 70E.
- G. All overcurrent protective devices required to be selectively coordinated per NEC 700 shall be properly coordinated and device settings shall be included in panelboard and switchboard enclosures with the corresponding panel schedules.

1.07 SUBMITTALS

- A. Product Data: Provide catalog data for nameplates, labels, and markers.
- B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- C. Arc-Flash Hazards Calculation: Provide complete arc-flash hazards calculation per NFPA 70E to Owner's Representative and Engineer for review and approval.

- D. Overcurrent Protective Device Coordination Study: Provide complete coordination study per NEC 700 to Owner's Representative and Engineer for review and approval.
- E. Underground Conduit Ductbanks: Provide site plan with identification names/numbers of individual conduits, vaults, and handholes for Owner's Representative and Engineer's review and approval.

1.08 QUALITY ASSURANCE

- A. Products: Listed and classified by Underwriters Laboratories (UL) as suitable for purpose specified as shown.
- B. Comply with NFPA 70 and NFPA 70E.

1.09 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications and with those required by codes and standards.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

PART 2 – PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Buried Electrical Lines: Underground warning tapes.
- B. Communication Cabinets: Nameplates.
- C. Conduit: Conduit Markers.
- D. Electrical Distribution and Control Equipment Enclosures: Nameplates.
- E. Transformers: Nameplates.
- F. Junction Box Load Connections: Wire Markers.
- G. Outlet Box Load Connections: Wire Markers.
- H. Outlet Box Wall Cover Plates: Laser Etching.
- I. Panel Gutter Load Connections: Wire Markers.

- J. Pull Box Load Connections: Wire Markers.
- K. Communication and Electrical Vaults: Nameplates.

2.02 NAMEPLATES AND LABELS

- A. Manufacturers:
 - 1. Marking Services, Inc. (MSI): <http://www.markserv.com>
 - 2. Double O Laser Services, Inc.: <http://www.doubleolaser.com>
 - 3. Or other reviewed and approved manufacturers.
- B. Panelboard, Distribution Board, and Equipment Disconnect Nameplates: Engraved plastic, high contrast for maximum visibility. 1/16" engraving plastic with either mounting holes or adhesive backing.
 - 1. Normal Power: White letters on black.
 - 2. Emergency Power: Black letters on orange.
 - 3. Panelboard and Distribution Board Labels:

Description:	Example:
Panel Name:	1M
Voltage:	480/277V
Amperes:	800A
Supplied From:	MSB-1

- 4. Equipment Disconnect Labels:

Description:	Example:
Equipment Name:	AHU-1
Voltage/Phase:	480V/3PH
Rated Load:	20HP
Supplied From:	PANEL 1M

- C. Load Equipment Nameplates: Laser engraved black impression stainless steel with brushed satin finish & permanent black impression.
 - 1. 430 Alloy, .029 thick.
 - 2. 1/8" holes for attachment to equipment with stainless steel self-drilling screws.
 - 3. Letter Size:
 - a. Load Equipment Name: use 0.375-inch letters.
 - b. All others: use 0.25-inch letters.

- D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches, receptacles, control device stations.
- E. Warning/Safety Labels: Industry standard self-adhesive warning/safety labels. Provide industry standard labeling, code required and per AHJ.

2.03 DEVICE AND JUNCTION BOXES

- A. Manufacturer pre-painted junction box cover plates:
 - 1. 480/277V Normal Power System: Yellow.
 - 2. 208/120V Normal Power System: Blue.
 - 3. Emergency Power System: Orange (painted inside and outside all other sides of box).
 - 4. Fire Alarm System: Red (painted inside and outside all other sides of box).
- B. Identify power circuits contained within junction boxes using permanent black ink marker with Panel Name and Circuit Number on cover plate of junction box.

2.04 OUTLET BOX COVER PLATES

- A. Laser etched with panel name and circuit number on stainless steel cover plates. Laser etching shall be by Marking Services, Inc. (MSI). Refer to the following for examples:

Panel Name – Circuit Number	-	2X4A – 22
Panel Name – Circuit Numbers	-	1M4A – 1,3,5

2.05 CONDUCTOR IDENTIFICATION

- A. Manufacturers:
 - 1. Brady Corporation: Model (B-702).
 - 2. Or other reviewed and approved Manufacturers.
- B. Description: Vinyl cloth type self-adhesive wire markers.
- C. Color: Black on White.
- D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings.
- E. Wire Color Coding:
 - 1. Single Phase, 3-Wire System: 120/240-Volt.
 - 2. Three Phase, 4-Wire System: 120/208-Volt.
 - 3. Three Phase, 4-Wire System: 277/480-Volt.
 - 4. Equipment Ground Wire: Green.
 - 5. Control wiring shall be black with identifying wire numbers at each termination.

6. Color-coded tape may be used in lieu of color-coded insulation for conductors #8 AWG and larger. However, when color coded tape is used, the conductor insulation shall be black only and shall be tape identified with color scheme shown above at splices, terminations, and junction boxes.

2.06 RACEWAY IDENTIFICATION

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Provide conduit identification at both ends of all Medium Voltage Conduits, Low Voltage Conduits, and Communications Conduits identifying systems contained within conduits and "to" location for other end of conduit. This requirement applies to both site underground conduits routed between vaults, buildings, and also conduits within Buildings.

2.07 CONDUIT MARKERS

- A. Location: Furnish markers for each conduit longer than 6-feet (2m).
- B. Spacing: 20-feet (6m) on center.
- C. Color:
 1. 480/277 Volt System: Yellow.
 2. 208/120 Volt System: Blue.
 3. Fire Alarm System: Red.
 4. Telecommunication System: Gray.
- D. Underground Conduit Entering Vaults:
 1. Brass conduit tags.
 2. .032-inch (20 gauge) brass.
 3. 3/16-inch hole for easy mounting.
 4. Top line 1/4-inch text with second line 1/2-inch number is standard.
 5. Tag shall identify conduit by system and location of other end of conduit. E.g., "FIBER – RM K104". Identify "SPARE" for system for empty conduits.

2.08 UNDERGROUND WARNING TAPE

- A. Underground Warning Tape: 3-inches (76 mm) wide polyethylene tape, detectable type colored red with suitable warning label describing buried electrical lines.
- B. Warning tape shall be acid and alkali-resistant and shall have a minimum strength of 1,750 psi lengthwise and 1,500 psi crosswise, with an elongation factor of 350%.

2.09 WARNING/SAFETY LABELS

- A. Self-adhesive, industry standard labels.
- B. Provide labels per code requirements and per AHJ.
- C. Provide the following label on front of all 208V or 240V Panelboards, Distribution Boards, and Switchboards:

CAUTION

AREA IN FRONT OF

ELECTRICAL PANEL

MUST BE KEPT CLEAR

FOR 36 INCHES

- D. Provide the following label on front of all 480V Panelboards, Distribution Boards, and Switchboards:

CAUTION

AREA IN FRONT OF

ELECTRICAL PANEL

MUST BE KEPT CLEAR

FOR 48 INCHES

- E. Provide the identification label/sign at all Emergency Power Off "EPO" pushbuttons, stating Panel Name pushbutton controls (shunts off).

2.10 CABLE TIES

- A. General-Purpose Cable Ties: Fungus insert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon:
 - 1. Minimum width: 3/16".
 - 2. Tensile strength at 73-degrees F, according to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185-degrees F.
 - 4. Color: Black.

2.11 MEDIUM-VOLTAGE (MV) CABLING IDENTIFICATION

- A. Manufacturers:
 - 1. Marking Services, Inc. (MSI): <http://www.markserv.com>
 - 2. Or other reviewed and approved Manufacturers.

- B. Provide identification tag on each cable, for each phase, at the following locations at minimum: each cable with load breaks in vaults, each cable looped in vaults, and each cable connecting to switches and transformers.
- C. Description: Engraved plastic, high contrast for maximum visibility. 1/16" engraving plastic with either mounting holes and zip-tied to cables.
- D. Color: White letters on black background.
- E. Identification Text: Include the following: Voltage, From Location to Current Location, and Electrical Phase. Example: 12KV MH31 – T30 A

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Degrease and clean surfaces to receive nameplates and labels.
- C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Self-Adhesive Identification Products: Clean surfaces before application, using materials, and methods recommended by manufacturer of identification device.
- F. Attach sign and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- G. Attach plastic raceway and cable leads that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- H. Install nameplates and labels parallel to equipment lines.
- I. Secure nameplates to equipment front using screws or rivets.
- J. Identify empty conduit at each end with permanent ink marker. Indicate function and termination location of other end.
- K. Identify underground conduits using underground warning tape. Install one tape per trench at 3-inches, or as indicated in Drawings, below finished grade.
- L. Each outdoor conduit shall be labeled with the location of the opposite end of the conduit, and numbered as C# (Where C stands for conduit and # is increased with each conduit in the set).

1. For example, if 2 conduits are installed between vault 101 and vault 102, both conduits in vault 101 shall have a weatherproof label and be labeled "C1 To Vault 102" and "C2 To Vault 102" while both conduits in vault 102 shall be labeled "C1 To Vault 101" and "C2 To Vault 101" respectively. If a conduit ends in a building, the building name and room number shall be labeled as the destination.

3.02 COMMISSIONING REQUIREMENTS

- A. The equipment and systems referenced in this Section shall be commissioned per Section 01 91 13 "General Commissioning Requirements" and per Section 26 08 00 "Commissioning of Electrical Systems". The Contractor has specific responsibilities for scheduling, coordination, startup, test development, testing, and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that apply to work under this Specification.

1.02 SUMMARY

- A. The purpose of this section is to specify the Contractor's responsibilities relative to Division 26 and participation in the commissioning process. Refer to Division 01, Section 01 91 00 "Commissioning" for Contractor related commissioning requirements.
- B. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from Division 26 for:
 - 1. Testing and startup of the electrical equipment.
 - 2. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure Division 26 equipment and systems are fully operational and ready for functional testing.
 - 3. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
 - 4. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill Contract and warranty requirements.
 - 5. Providing training for the systems specified in Division 26 with the coordination of the Owner by the Commissioning Authority.
- C. Division 26 shall cooperate with the Commissioning Authority in the following manner:
 - 1. Allow sufficient time before final completion dates so that electrical testing, lighting control checkout, and functional testing can be accomplished.
 - 2. Provide labor and material to make corrections when required without undue delay.
 - 3. Put all electrical systems and equipment into full operation and continue the operation of the same during each working day of commissioning.

- D. Test the entire electrical installation to assure compliance with Codes and proper system operation.
- E. Electrical systems commissioning consists of static checks of component and system installations and actual testing of equipment conditions and functions.
- F. The Commissioning Authority shall review and approve, prior to use, all test procedures and forms used and shall witness a varying fraction of the checks and testing performed by the Contractor. The Commissioning Authority shall review the completed check and test documentation of the Contractor for all checks and tests.

1.03 SUBMITTALS

- A. Thirty (30) days before any testing is conducted, submit an overall testing plan and schedule for electrical systems that lists the equipment, modes to be tested, dates of testing and parties conducting the tests. Put these tests into the master construction schedule. Keep this plan and schedule updated throughout the Project.

1.04 QUALITY ASSURANCE

- A. A Certified Testing Company shall perform the work of this Section, and shall be qualified to test electrical equipment, and is a NETA (National Electrical Testing Association) Certified Testing Agency. The Certified Testing Company shall not be associated with the manufacturer(s) of the equipment or systems under test.
- B. The Contractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on this Project.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Standard certified test equipment for commissioning shall be provided by the Commissioning Authority.
- B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

2.02 MATERIALS AND INSTRUMENTATION

- A. All testing and commissioning materials and instrumentation shall be provided by and remain the property of the Contractor.

PART 3 – EXECUTION

3.01 WORK PRIOR TO COMMISSIONING

- A. Specific pre-commissioning responsibilities of Division 26 are as follows:
 - 1. Normal startup services as required to bring each system into a fully operational state.
 - 2. Complete pre-functional test checklists for all equipment and systems to be commissioned.
 - 3. Portions of mechanical equipment startup requiring electrical connections and metering.
 - 4. Factory startup services for key equipment and systems specified in Division 26. The Division 26 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.
 - 5. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.

3.02 PARTICIPATION IN COMMISSIONING

- A. The Division 26 Contractor shall provide skilled technicians to startup and debug all systems within the Division 26 work (particularly with lighting equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor shall ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation, and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job and work done. A liaison or intermediary between the Commissioning Authority and qualified factory representative does not constitute the availability of a qualified technician for purposes of this work.
- C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
 - 1. Power for mechanical systems.
 - 2. Lighting control systems.
 - 3. Daylighting control systems.
 - 4. Emergency power systems and restart testing.
 - 5. Uninterruptible power systems.
 - 6. Photovoltaic power systems.

3.03 WORK TO RESOLVE DEFICIENCIES

- A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet acceptable performance.
- B. Correction of work will be completed under the direction of the Owner/Architect and Engineer, with input from the Contractor, Equipment Supplier, and Commissioning Authority.
- C. All members will have input and the opportunity to discuss, debate, and work out problems, and the Architect/Engineer will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.04 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the Spring and Fall. Initial commissioning will be done as soon as Contract work is completed regardless of the season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.
- B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum, and at peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.05 ELECTRICAL SYSTEM TESTING

- A. Conform to Commissioning Requirements.
- B. Electrical system testing as required in other sections of this Specification shall be coordinated with the Commissioning Authority. The Commissioning Authority may witness testing performed by the Division 26 Contractor.
- C. All testing documentation related to Division 26 equipment and systems, as specified in other sections of this Specification, will be provided to the Commissioning Authority for use and review.
- D. Test wiring and electrical equipment to verify absence of grounds and short circuits, and verify proper operation, rotation, and phase relationships. Upon request, demonstrate operation of all equipment in accordance with the requirements of this Specification and the manufacturer's recommendations. Provide instruments and personnel required to conduct these tests.

3.06 CHECKS AND TESTS

- A. Checks are intended to begin upon completion of a component or equipment installation. Testing generally occurs later when systems are energized or nearing that point. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system as soon as possible, including all construction checklists and may require retesting portions of the system once all components are fully functioning.
- B. The check and test procedures and record forms shall contain the following:
 - 1. The Subcontractor(s) executing checks and/or tests.
 - 2. A list of the integral components being inspected and tested, equipment tag numbers, manufacturer, model number, pertinent performance information/rating data.
 - 3. Test equipment used.
 - 4. Construction checklists associated with the components, if any.
 - 5. Any special required conditions of the checks or tests for each procedure.
 - 6. Items, conditions, or functions to be inspected, verified or tested, the checks and testing method given and a place provided with results recorded.
 - 7. Acceptance criteria (or reference by specific table where the acceptance criteria is found).
 - 8. For each procedure, list the technician performing the checks or tests and company, witnesses of the tests, and dates of tests.
 - 9. Sampling strategies used.
- C. The test procedures for dynamic equipment like lighting controls, emergency generator, or fire alarm system shall contain more step-by-step procedures. The test procedures and forms for more static components like panelboards, switchgear, circuit breakers, transformers, etc., can
- D. At the Commissioning Authority's discretion, if large numbers or repeated deficiencies are encountered, the Contractor shall test and troubleshoot all remaining systems at issue on their own before commissioning with the Commissioning Authority resumes.
- E. Sampling for Identical Units: When there are a number of identical units, at the Commissioning Authority's discretion, some or all procedures of a test for a piece of equipment or assembly may be omitted when these same tests on other pieces of identical equipment or assemblies were conducted without deficiency.

3.07 LOAD BALANCE

- A. Checks shall be made for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.
- B. Record all circuit changes on the As-Built Drawings.

- C. Do not fabricate nameplates, or coverplates' labelling, prior to load balance test and adjustments.

3.08 GROUNDING TEST

- A. Measure the Ohmic value of the existing electrical service entrance metallic "Electrical System Ground" with reference to "Earth Ground" using the "Multiple Ground Rod" method and suitable instruments. Maximum resistance to ground shall be less than 10 ohms. If this resistance cannot be obtained, notify the Architect and Engineer in writing.
- B. Provide paper copy of the test results in the record O&M manuals.

3.09 EQUIPMENT SPECIFIC TESTING

- A. The following paragraphs define the testing requirements for each type of system or feature that is a part of this Project. The Commissioning Authority shall use this information to develop specific testing procedures for each of the systems to be commissioned. The Contractor shall be responsible for support, execution, and coordination of these tests as described in the Project Specifications, including intersystem tests and interlocks with systems in other Divisions.
- B. Common Testing Requirements:
 - 1. The following requirements apply to all electrical systems and features that are to be commissioned when referenced below. Tests shall:
 - a. Verify functionality and compliance with the design intent for each individual sequence module in the sequences of operation. Verify proper operation of all control strategies, energy efficiency, and self-diagnostics, by stepping through each sequence and documenting equipment and system performance. Test every step in every written sequence and other significant modes, sequences, and operational features not mentioned in written sequences. These shall include: startup, normal operation, shutdown, scheduled on/off, unoccupied and manual modes, safeties, alarms, overrides, lockouts, and power failure.
 - b. Verify all alarm and high and low limit functions, and messages generated on all points with alarm settings.
 - c. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.
 - d. Verify shutdown and restart capabilities both for scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).
 - e. When applicable, demonstrate a full cycle from off to on and no load to full load and then to no load and off.
 - f. Verify time of day schedules and setpoints.
 - g. Verify all energy saving control strategies.

- h. Verify that monitoring system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.
 - i. Verify operator control of all commandable control system points including proper security level access.
 - j. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA test procedures shall be part of the testing requirements of this Specification. Additional testing procedures may be listed in this Specification.
- C. Common Acceptance Criteria:
 - 1. The following common acceptance criteria apply to all equipment, assemblies, and features:
 - a. For the conditions, sequences, and modes tested, the equipment, integral components, and related equipment shall respond to varying loads, and changing conditions, and parameters appropriately as expected, according to the sequences of operation, as specified, according to acceptable operating practices, and the manufacturer's performance specifications.
 - b. Verify that equipment operates within tolerances specified in: governing codes, acceptance criteria contained in construction documents, manufacturer's literature, and according to good operating practice.
 - c. Systems shall accomplish their intended function and performance.
 - d. All safety trips shall require a manual reset to allow a system restart.
 - e. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.
 - f. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.)
 - g. Other acceptance criteria are given in the equipment testing requirement articles or reference standards.
 - h. Additional acceptance criteria will be developed by the Commissioning Authority when detailed test procedures are developed.
 - i. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for electric power distribution equipment and systems, the NETA performance criteria shall apply.

3.10 TRAINING

- A. The Division 26 Contractor will be required to participate in the training of the Owner's Engineering and Maintenance Staff for each electrical system and the related components. Training may be conducted in a classroom setting, with

system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Low-voltage lighting control system.

1.02 RELATED REQUIREMENTS:

- A. Division 01 - General Requirements.
- B. Division 26 Section "Common Work Results for Electrical".
- C. Division 26 Section "Basic Electrical Materials and Methods".
- D. Division 26 Section "Low-Voltage Wires (600 Volt AC)".
- E. Division 26 Section "Raceways, Boxes, Fittings, and Supports".
- F. Division 26 Section "Electrical Systems Commissioning".
- G. Division 26 Section "Panelboards".
- H. Division 26 Section "Interior Lighting".
- I. Division 26 Section "Exterior Lighting".

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer's review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.
- C. Manufacturer's Data: Submit catalog cuts and description of each system component.
- D. Provide wiring diagrams and installation details for lighting control equipment.

- E. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.
- F. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensors locations based on manufacturer's recommendations, and system components with manufacturer's part numbers.
- G. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.
- H. Software flow diagram of and complete sequence of operation.
- I. Software licenses and electronic keys, and list of assigned passwords.
- J. Supplemental local or factory training schedule for post warranty support.
- K. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.

1.04 QUALITY ASSURANCE

- A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
- B. Lighting Control Systems shall comply with Local and National Electrical Codes, and Local Energy Codes in effect at time of submittal for building permit.
- C. Conduct a coordination meeting to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer's recommendations.
- D. Systems components shall be Title 24 and ASHRAE 90.1 compliant.

1.05 WARRANTY

- A. Manufacturer shall provide a (5) year material warranty.

1.06 SYSTEM REQUIREMENTS

- A. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).
- B. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light

controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.

1. Software shall be resident within the lighting control system.
 2. System shall provide local access to programming functions at the master Central Lighting Control Panel (CLCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.
 3. System software shall provide real time status of all components and ancillary devices.
 4. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming
- C. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.
- D. The system shall have a server built into the master CLCP. The server shall effectively work/operate through HTML pages from any authorized workstation.
1. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mbps to the local area network.
 2. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.
- E. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
- F. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable
- G. Devices shall be factory pre-addressed as well as have the ability to be field addressable. Systems requiring field addressing only are not acceptable.
- H. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- I. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or local energy code requirements.

- J. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.
- K. Programming and scheduling shall be done at the master CLCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.
- L. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including centralized and remote room controllers, digital switches, etc. shall be able to be added to the network.
 - 1. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.
 - 2. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.
- M. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer's instructions.
- N. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.

1.07 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

- A. Corridors and Open Areas:
 - 1. Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.
 - a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.
 - b. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
 - c. Interior corridors require occupancy sensors.
- B. Custodial, Unsupervised and Equipment Rooms:
 - 1. Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 20 minute pre-set programmable timeout after the room has been vacated.
- C. Exterior Security Lights:
 - 1. Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.

- a. Program lights to ON state when natural lighting is below 5 foot-candles
 - b. Program lights to OFF when natural light level is greater than 5 foot-candles.
- E. Exterior, Non-Security Lights:
 - 1. Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
 - b. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.
- F. Restrooms:
 - 1. Private Restroom:
 - a. Provide a wall mounted line voltage sensor switch adjacent to the door.
 - b. The sensor shall turn off the lights via a programmable pre-set 20 minute timeout after the room has been vacated.
 - 2. Public Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
 - a. Public Restroom lights shall be controlled from by a RRC or CLCP.
 - b. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.
 - c. Sensor shall turn off the lights via a programmable pre-set 20 minute timeout.
- J. G. Emergency Lighting:
 - 1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.
 - 2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.

PART 2 - PRODUCTS

2.01. CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located in electrical closets.
- B. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:

1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.
2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120, 277 and 347 VAC compartments as well as "normal and emergency" compartments.
3. Lighting control relays as indicated on Drawings. If required provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.
4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.
5. Each panel shall be rated for 120/277 VAC or 120/347 VAC.
6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120, 277 or 347 VAC.
7. Shall have the ability to add additional modules within the control panel for expanded capabilities such as 0-10V outputs and contact closure inputs.
8. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior daylight sensors, exterior daylight sensors, and associated control electronics shall be furnished by Universal Douglas.
9. Approved products: Universal Douglas Dialog WLCP Series.

2.02. DIALOG ROOM CONTROLLERS

- A. Dialog Room Controllers (DRC) shall be mounted in the ceiling space as indicated on plans.
 1. Each DRC shall be capable of connecting to the network lighting control system using manufacturer's recommended wiring method and configuration.
 2. Provide a printed label "RLCP" to the T-bar grid below the DRC.
- B. Each DRC shall contain the following hardware features:
 1. Digital dataline switch inputs
 2. Digital dataline type inputs for occupancy and daylight sensors.
- C. Each RCC shall be able to accept an expansion module with the following features:
 1. Two additional programmable relays
 2. Relays capable of switching 20 amps lighting loads for 120, 277 or 347 VAC.
 3. Relays capable of switching 120 VAC receptacle loads
 4. UL924 rating for each relay so that upon power loss, each relay goes to ON position
- D. Approved products: Universal Douglas WRC-4244, WRC-4222, WUL-4924

2.03 RELAYS

- A. Each lighting control relay shall be capable of controlling incandescent, fluorescent, LED sources, and HID lighting loads. Relays not rated for all types of lighting loads are not acceptable.
- B. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.
- C. Approved Products:
 - 1. Single Pole: Universal Douglas WR-6161.
 - 2. Double Pole: Universal Douglas WR-6172.

2.04 LOW VOLTAGE SWITCHES

- A. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.
 - 1. Provide stainless steel switch plates, unless noted otherwise in construction documents.
 - 2. Approved Products: Universal Douglas WSD-450x, WSW-35xx, WSW-451x series.
- B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.
- C. Keyed switches shall be digital.
 - 1. Approved products: Universal Douglas WSK-3502 Series
 - 2. Provide stainless steel switch plates, unless noted otherwise in construction documents.
- D. High abuse areas shall be controlled using a vandal resistant, touch sensitive high abuse switch.
 - 1. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews' activities.
 - 2. Switches shall be digital or analog as indicted on plans.
 - 3. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.
 - 4. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions.
 - 5. Approved products: WSW-VANDAL series

2.05 INTERIOR DAYLIGHT SENSORS

- A. Provide daylight sensors in all rooms with windows, skylights, or daylight filtration. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.

- B. Daylight sensors shall be capable of sensing from 0-65,000 lux/0-6,500fc of direct light. The sensor shall derive both power and data information from the Dialog digital dataline; wiring comprised of (2) #18AWG conductors.
- C. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels. Sensors shall be capable of controlling multiple daylight zones simultaneously.
- D. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.
- E. Each interior daylight sensor shall continuously monitor the true light level and shall broadcast this level to lighting control network.
- F. Controllers offering single set point controls are not acceptable.
- G. It shall be possible to set a maximum threshold light level which cannot be exceeded during Natural Daylight operations or for non-daylight controlled areas, lighting can be tuned to a level less than 100% full bright to maximize energy savings.
- H. Approved Products: Universal Douglas WPS-4741

2.06 EXTERIOR DAYLIGHT SENSORS

- A. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.
- B. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.
- C. Sensors shall be UL or NRTL listed for exterior application.
- D. Approved products: Universal Douglas WPS-3741B

2.07 DIMMING CONTROLLERS

- A. System control devices shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.
- B. LED Drivers using proprietary control protocols shall not be acceptable.
- C. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.

- D. Photocells settings must be remotely accessible.
- E. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.
- F. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Threshold trip points shall be able to be programmed and altered remotely via programming functions at the master Central Lighting Control Panel (CLCP) and remote access to programming functions via computers or other intelligent communication devices.
- G. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.
- H. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.
- I. Approved Products: Dialog Series

2.08 INTERIOR OCCUPANCY/VACANCY SENSORS

- A. System Sensors:
 - 1. Ceiling-Mounted Dual Technology Sensors:
 - a. Sensors shall be dual technology utilizing infrared and ADI-Voice capable of detecting presence in floor area to be controlled, by detecting human speech and infrared technology.
 - b. Sensors shall have a 360 degree coverage pattern with an adjustable tilt head to maximize coverage, focus on particular areas, or provide adjustment when mounted on sloped ceilings.
 - c. Sensors shall provide an adjustable time out period of 30 seconds to 30 minutes.
 - d. Sensors shall be capable of daisy chain, star, and t-tap connection to the controller.
 - e. Each sensor shall be furnished with a convenient shunt provision allowing user to by-pass sensor in event of failure.
 - f. Approved products: Universal Douglas Dialog Sensors
WORS DG1-BPR-N, WORX DG1-BPR-N, WORBDG1-BPR-N
- B. Line Voltage Sensors:
 - 1. Dual Technology Passive Infrared Wall Switch Sensor with Daylight Controls:
 - a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.

- b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
- c. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.
- d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
- e. Time delay range shall be adjustable from 30 seconds to 30 minutes.
- f. Sensitivity adjustment shall range from hi, medium, and low.
- g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- h. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.
- i. Sensor shall be a completely self-contained control system.
- j. Power shall be provided via an internal transformer.
- k. Switching mechanism shall be a latching dry contact relay.
- l. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
- m. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
- n. Sensors shall be dual voltage, 120 volt and 277 Volt.
- o. Approved products: Universal Douglas WOSSDU1-P-VW, WOSSDU2-P-VW

PART 3 – EXECUTION

3.01 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.
- B. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
- C. Installation shall meet or exceed standard practice of workmanship and quality.
- D. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.

3.02 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
- B. Provide digital type switches and make all connections according to lighting control manufactures requirements.
- C. Central Lighting Control Panels and Dialog Room Controllers shall be connected via a data line. Connect lighting control system per manufacturer's requirements. Do not exceed manufacturer's total data line length requirement.
- D. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- E. Panel locations shall be furnished with enough working space around panels to comply with Local and National Electrical Code.
- F. Panels shall be securely fastened to the mounting surface by at least four points.
- G. Unused openings in the cabinet shall be effectively closed.
- H. Cabinets shall be grounded in accordance with the National Electrical Code, and manufacturer's recommendations.
- I. Lugs shall be suitable and listed for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside cabinets.
- L. Clean cabinets of foreign material such as cement, plaster and paint.
- M. Distribute and arrange conductors neatly in the wiring gutters.
- N. Follow the manufacturer's torque values to tighten lugs.
- O. Before energizing the panelboard, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
 - 2. Remove shipping blocks from component devices and the panel interior.
 - 3. Remove debris from panelboard interior.
- P. Follow manufacturers' instructions for installation.

3.03 OPERATING/SERVICE MANUALS

- A. Service and Operation Manuals:
 - 1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
 - 2. Record drawings: Provide (3) printed and one electronic copy on flush media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.
 - 3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.04 PROTECTION

- A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.05 TESTING

- K. A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:
 - 1. Confirmation of system programming.
 - 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
 - 3. Operation of system's features under normal and emergency operations.
 - 4. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
 - 5. Confirm system operations and functionality.
 - 6. Check system interface response to other systems such as fire alarm and emergency power system conditions.

3.06 SPARE PARTS

- A. Provide no spare parts

3.07 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Lighting and Appliance Branch-Circuit Panelboards.
- B. Panelboards: Furnish and install panelboards as specified herein and as shown on the Drawings.

1.03 RELATED SECTIONS

- A. Division 26 05 53 "Identification for Electrical Systems".

1.04 DEFINITIONS

- A. ATS: Acceptance Testing Specification.
- B. GFCI: Ground-Fault Circuit Interrupter.
- C. GFEP: Ground-Fault Equipment Protection.
- D. HID: High-Intensity Discharge.
- E. MCCB: Molded Case Circuit Breaker.
- F. SPD: Surge Protective Device.
- G. VPR: Voltage Protection Rating.

1.05 REFERENCES

- A. NEMA PB 1 – Panelboards.
- B. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards, Rated 600 Volts or Less.

- C. NEMA AB 1 – Molded Case Circuit Breakers.
- D. UL 50 – Enclosures for Electrical Equipment.
- E. UL 67 – Panelboards.
- F. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.
- G. CSA Standard C22.2 No. 29-M1989 – Panelboards and Enclosed Panelboards.
- H. CSA Standard C22.2 No. 5-M91 – Molded Case Circuit Breakers.
- I. Federal Specification W-P-115C – Type 1, Class 1.
- J. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.
- K. NFPA 70 – National Electrical Code (NEC).
- L. ASTM – American Society of Testing Materials.

1.06 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Submit catalog cut sheets for all items proposed to be furnished and installed under this Section.
- C. Provide complete submittal information. Approved documents shall include factory shop drawings, details, and wiring diagrams.
- D. Product Data: For each type of panelboard:
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- E. Shop Drawings: For each panelboard and related equipment:
 - 1. Provide shop drawings which contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one-line diagrams with applicable voltage systems.
 - 2. Include dimensioned plans, elevations, sections, and details.
 - 3. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 4. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 5. Detail bus configuration, current, and voltage ratings.

6. Short-circuit current rating (SCCR) of panelboards and overcurrent devices.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Include evidence of NRTL listing for SPDs as installed in panelboards.
9. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, and auxiliary components.
10. Include wiring diagrams for power, signal, and control wiring.
11. Key interlock scheme drawing and sequence of operations.
12. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit and install final versions after load balancing.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed that are packaged with protective covering for storage and identified with labels describing contents:
 1. Keys: 2 spares for each type of panelboard cabinet lock.

1.09 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data", include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.10 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: ISO 9001 or 9002 certified.
- C. Manufacturer shall have specialized in the manufacturing and assembly of panelboards for at least 50-years.
- D. Furnish products listed by Underwriters Laboratories (UL).

- E. The manufacturing facility shall be recognized by UL to the International Organization for Standardization ISO 9002 Series Standards for quality.
- F. Contractor shall be responsible to provide overcurrent protective devices, which selectively coordinate as required per Codes. Contractor shall be responsible to provide Overcurrent Protective Device Coordination Study per Section 26 05 53 "Identification for Electrical Systems".
- G. Contractor shall be responsible to provide arc-flash hazards labeling as required per Codes. Contractor shall be responsible to provide Arc-Flash Hazards Calculation per Section 26 05 53 "Identification for Electrical Systems".

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Remove loose packing and flammable materials from inside panelboards.
- C. Install temporary electric heating (250 W per panelboard) to prevent condensation.
- D. Handle and prepare panelboards for installation according to NEMA PB 1.
- E. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- F. Store in a clean, dry environment. Maintain factory packaging, and if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.12 OPERATIONS AND MAINTENANCE MANUALS

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards, rated 600 volts or less.

1.13 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 degrees F to plus 104 degrees F.
 - b. Altitude: Not exceeding 6,600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude: Not exceeding 6,600 feet.
- C. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by the Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to the requirements indicated:
 - 1. Notify the Owner no fewer than two (2) business days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.14 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period:
 - 1. Panelboard Warranty Period: 18-months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which the manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: 5-years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Cutler-Hammer (basis of design).
- B. Siemens.
- C. Square D (Schneider Electric).
- D. Approval of the above manufacturers is contingent on their equipment size to be suitable for the installation situation and physical space indicated on the Drawings. Manufacturer shall verify this requirement.

2.02 PANELBOARDS COMMON REQUIREMENTS

- A. Load center type panelboards are not allowed.
- B. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 05 48 "Seismic Controls for Electrical Systems".
- C. Comply with NEMA PB 1.

- D. Comply with NFPA 70.
- E. 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.
- F. Product selection for restricted space. Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- G. Enclosures: Flush and surface mounted, dead-front cabinets:
 - 1. Maximum enclosure dimensions shall not exceed 21" wide and 6.5" deep and 84" high.
 - 2. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Locations: NEMA 250, Type 3R.
 - e. Indoor Locations subject to dust, falling dirt, and dripping noncorrosive liquids: NEMA 250, Type 12.
 - 3. Type 1 Boxes:
 - a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
 - b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs.
 - c. Box width shall be 20" wide maximum.
 - 4. Type 1 Fronts:
 - a. Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over-cleaned phosphatized steel.
 - b. Fronts shall be door-in-door, hinged 1-piece. Mounting shall be flush or surface as indicated on schedules and/or Drawings. Hinged door-in-door trim shall be:
 - 1) Rooms or areas accessible to anyone: Hinged Door-in-Door with inner door lock and outer door is retained with screws.
 - 2) Electrical rooms or other locked rooms only accessible to qualified personnel: Hinged Door-in-Door with inner door lock and outer door lock. Doors shall not require screw removal to open, they shall be able to open by unlocking the locks.
 - c. Hinged wiring access cover shall be secured with screws. Key-lock is not acceptable.
 - d. Door for circuit breaker access shall be hinged and have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of the door.

5. Type 3R, 5, and 12:
 - a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of the door.
 6. Skirt for Surface Mount Panelboards: Same gauge and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 7. Gutter Extension and Barrier: Same gauge and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 8. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finish immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel and same finish as panelboards and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent devices and other components.
- H. Interior:
1. Shall be voltage and ampere rated, as indicated on associated schedules and drawings, not to exceed 600 amperes maximum.
 2. Short-circuit current ratings (SCCR) as specified on panel schedules. Ratings shall not be less than the following:
 - a. 22,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. 18,000 rms symmetrical amperes at 480 VAC.
 3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and – G.
 4. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers over 100 amps shall be vertically mounted. Main lug interiors up to 400 amps shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mount applications.
- I. Incoming Mains:

1. Location: Top, Bottom, or Convertible between top and bottom as required.
 2. Main Breaker: Main lug interiors up to 400 amps shall be field convertible to main breaker.
- J. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors, bonded to the box.
 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors, insulated from the box.
 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from the enclosure. Do not mount neutral bus in gutter.
 6. Extra-Capacity Neutral Bus: Neutral bus rated 200-percent of the phase bus and listed and labeled by an NRTL, acceptable to Authority Having Jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on the Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on the Drawings. Do not mount neutral bus in gutter.
 7. Split Bus: Vertical buses divided into individual vertical sections.
- K. Conductor Connectors: Suitable for use with conductor material and sizes:
1. Material: Hard-drawn copper, 98-percent conductivity.
 2. Terminations shall allow use of 75-degree C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Mechanical type, suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200-percent of phase lugs, mounted on extra-capacity neutral bus.

- L. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
- M. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the Panel Schedules in the Drawings.
- N. Split solid neutral shall be plated and located in the mains compartment up to 225 amps so all incoming neutral cable may be of the same length.
- O. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed circuit breaker knock-outs covering unused mounting space.
- P. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. Percentage of future space capacity shall be 20-percent minimum.
- Q. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to Authority Having Jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- R. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short-circuit current ratings shall all be displayed on the interior or in a booklet format.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit Breaker or Lugs only as shown on Drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general purpose controller, with same SCCR as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to the main bus ahead of the contactor connection.
 - 2. External Control-Power Source: 120 volt branch-circuit.
- E. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

- F. Doors: Door-in-Door construction with concealed hinges; secured with multi-point latch with tumbler locks; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed unless the outer door is open.

2.04 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating, circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the Drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated in the Panel Schedules, but not less than:
 - 1) 22,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 18,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 5. Shall be molded case type circuit breakers, unless required to be electronic-trip for selective coordination.
 - 6. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
 - 7. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
 - 8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
 - 9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
 - 10. Do not use tandem circuit breakers.
 - 11. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
 - 12. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amps shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles.

Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

13. Breaker handle/faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.
14. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking the handle in the ON or OFF position.
15. Lugs shall be UL listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90 degrees C rated wire, sized according to the 75 degrees C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
16. The circuit breakers shall be UL listed for use with the following accessories: Shunt-Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

B. Main Circuit Breaker:

1. Shall be molded case type circuit breakers, unless required to be electronic-trip for selective coordination.
2. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.

C. Branch Circuit Breakers:

1. Circuit breakers shall be UL listed with ampere ratings, interrupting ratings, and number of poles as indicated on the associated Panel Schedules and Drawings.
2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a trip indicator appearing in the clear window of the circuit breaker housing.
5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
6. Lugs shall be UL listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90 degrees C rated wire, sized according to the 75 degrees C temperature rating per NEC Table 310-16.

Branch circuit breakers rated 30 amps and below shall be UL listed to accept 60 degrees C rated wire.

7. Breakers shall be UL listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.

2.05 ACCESSORIE, COMPONENTS, AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device tests, inspections, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard, include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

2.06 IDENTIFICATION

- A. Provide labelling as required in Section 26 05 53 "Identification for Electrical Systems".
- B. Panelboard Labels: Manufacturer's name and trademark, voltage, amperes, number of phases, and number of poles shall be located on the interior of the panelboard door.
- C. Breaker Labels: Faceplates shall list current rating, UL and IEC certification standards, and AIC rating.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic cover.
 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Comply with NECA 1.
- B. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1, and NEC Standards.
- C. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- D. For all new panelboards, provide minimum of four (4) additional 1-inch spare conduits with pull-strings from panelboard to above accessible ceiling for future

circuits. Additionally, stub four (4) 1-inch spare conduits into raised floor space or below slab not on grade.

- E. Panelboard Mounting:
 - 1. Install panelboards on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete".
 - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 3. Comply with requirements for seismic control devices as specified in Section 26 05 48 "Seismic Controls for Electrical Systems".
 - 4. Mount top of trim 90-inches above finished floor, unless otherwise indicated.
 - 5. Mount panelboard cabinet plumb and rigid without distortion of the box.
 - 6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 - 7. Mount surface-mounted panelboards to steel slotted supports 5/8 inch or 1-1/4 inch, as required, in depth. Orient steel slotted supports vertically.
- F. Comply with mounting and anchoring requirements specified in Section 26 05 48 "Seismic Controls for Electrical Systems".
- G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from panelboards.
- H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- J. Arrange conductors in gutters into groups, bundle, and wrap with wire ties after completing load balancing.
- K. Install filler plates in unused spaces.
- L. Panel Schedules: Provide a typed index card of circuits, listing each circuit by proper designation, on back of each cabinet door under plastic cover. Spares and spaces to be entered in pencil. Panel Schedules shall be completed with specific (what and where) information.
- M. Labeling: Provide nameplate and labeling as required in Section 26 05 53.
- N. Panels that are over-sprayed with wall paint must be cleaned and refinished. Otherwise, remove and replace equipment with new.

- O. Cleanup: After construction is complete, vacuum panels, equipment, cabinets, and switchboards to remove dust, rust, and debris.

3.02 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Manufacturer's Field Service:
 - 1. Perform tests and inspections as required.
 - 2. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations; including connections, and to assist in testing.
- C. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20-percent of each other. Maintain proper phasing for multi-wire branch circuits.
- D. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written requirements. Provide documentation of the torque connections to engineer for closeout documentation. If values do not match manufacturer recommendation, contractor to provide additional torqueing and provide documentation that the requirements have been adhered to.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 "Circuit Breakers" and Paragraph 7.19.1 "Surge Arrestors", low-voltage. Perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. 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 panelboard. 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 panelboard 11-months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device(s).
- F. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- G. Panelboards will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.03 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.04 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by the manufacturer.
- B. Set field-adjustable circuit breaker trip ranges as indicated or as shown in the Overcurrent Protective Device Coordination Study, where applicable.
- C. Load Balancing: After Substantial Completion, but not more than 60-days after Final Acceptance, measure load balancing and make circuit changes as required to keep phase loads within 20% of each other. Prior to making circuit changes to achieve load balancing, inform Owner's Representative of effect on phase color coding.
1. Measure load during period of normal facility operations.
 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Owner's Representative. Avoid disrupting services such as computers and on-line data processing, computing, transmitting and receiving equipment.
 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20-percent.

3.05 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems".
- B. Identify field-installed conductors, interconnecting wiring, and components.

- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- D. Panelboard Nameplates: Label each panelboard with a nameplate.
- E. Device Nameplates: Label each branch circuit device in panelboards with a nameplate.
- F. Install warning signs and also identify source of remote circuits where applicable.

END OF SECTION

SECTION 26 27 17

EQUIPMENT WIRING

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Provide complete electrical connections to equipment.

1.03 RELATED SECTIONS

- A. Division 26 Section "Raceways and Boxes".
- B. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- C. Division 26 Section "Wiring Devices".
- D. Division 26 Section "Grounding and Bonding".

1.04 REFERENCES

- A. NEMA WD 1 – General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- B. NEMA WD 6 – Wiring Devices – Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2012).
- C. NFPA 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by the Authority Having Jurisdiction, Including all applicable amendments and supplements.

1.05 SUBMITTALS

- A. Submit under provisions of Division 01.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified, indicated, and intended.

1.07 GENERAL REQUIREMENTS

- A. Provide detailed wiring diagrams to interconnect components for complete operation of various electrical systems, including devices and components provided under other Sections of the Construction Documents.
- B. Provide layouts of equipment and details of mounting method for approval prior to installation to ensure proper execution of the Work.
- C. Drawings are diagrammatic and indicated generally the locations of materials and equipment, and shall be followed as closely as possible. Coordinate the Work under this Section with the Architectural, Structural, Plumbing, Heating and Air Conditioning, and the Drawings of other trades for exact dimensions, clearances, and roughing-in locations. Cooperate with other trades in order to make minor field adjustments to accommodate the work of others.
- D. All devices, outlets, cabinets, equipment, panels, light fixtures, and switches can be field located by Owner's Representative within 20-feet of designed locations prior to rough-in work without extra compensation.
- E. Coordinate electrical work with mechanical installations. Verify final mechanical equipment locations with mechanical installer prior to commencement of electrical work. Connect power wiring to mechanical equipment through starters, VFDs, and contactors as required. Maintain clearances around mechanical equipment to allow access for maintenance per NEC codes and local codes.
- F. Coordinate wiring interconnections for the complete operation of electrical-mechanical equipment to include items provided by other divisions. Examine equipment connection information with manufacturer's shop drawings and submittals.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provide with equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction NFPA 70, Type SO, multi-conductor, flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

- B. Disconnect Switches: As specified in Sections 26 28 16 "Enclosed Switches" and 26 29 13 "Enclosed Controllers", and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26 "Wiring Devices".
- D. Raceways and Boxes: As specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems".
- E. Wires and Cables: As specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connections in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet(s) to accommodate connection(s) with attachment plug(s).
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Section Includes:
 - 1. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
 - 2. USB charger devices.
 - 3. GFCI receptacles.
 - 4. Hazardous (classified) location receptacles.
 - 5. Twist-lock receptacles.
 - 6. Toggle switches.
 - 7. Decorator-style convenience devices.
 - 8. Wall switch sensor light switches with dual-technology sensors.
 - 9. 120V stand-alone fire alarm smoke and combination smoke/CO detectors with battery backup.

1.03 RELATED SECTIONS

- A. Division 26 Section "Raceways and Boxes".
- B. Division 26 Section "Grounding and Bonding".
- C. Division 26 Section "Identification for Electrical Systems".

1.04 REFERENCES

- A. FS W-C-596 – Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 – Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 – Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.

- D. NEMA WD 1 – General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- E. NEMA WD 6 – Wiring Device – Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R 2012).
- F. NFPA 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by the Authority Having Jurisdiction, including all applicable amendments and supplements.
- G. UL 20 – General-Use Snap Switches; Current Edition, including all revisions.
- H. UL 498 – Attachment Plugs and Receptacles; Current Edition, including all revisions.
- I. UL 514D – Cover Plates for Flush-Mounted Wiring Devices; Current Edition, including all revisions.
- J. UL 943 – Ground-Fault Circuit-Interrupters; Current Edition, including all revisions.
- K. UL 1449 – Standard for Surge Protective Devices; Current Edition, including all revisions.
- L. UL 1472 – Solid-State Dimming Controls; Current Edition, including all revisions.
- M. UL 1917 – Solid-State Fan Speed Controls; Current Edition, including all revisions.

1.05 DEFINITIONS

- A. BAS: Building Automation System.
- B. EMI: Electromagnetic Interference.
- C. GFCI: Ground-Fault Circuit Interrupter.
- D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- E. RFI: Radio-Frequency Interference.
- F. SPD: Surge Protective Device.
- G. UTP: Unshielded Twisted Pair.

1.06 SUBMITTALS

- A. Submit under provisions of Division 01.

- B. Submit catalog cuts for all items proposed to be furnished and installed under this Section.
- C. Product Data: For each type of product, provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
 - 2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR), for all protection modes and diagnostics information.
- D. Shop Drawings: List of legends and description of materials and processes used for premarking wall plates.
- E. Samples: One for each type of device and wall plate specified, in each color specified.
- F. Project Record Documents: Record actual installed locations of all wiring devices.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of the Project:
 - 1. Refer to Division 01 for additional provisions.
 - 2. Service/Power Poles: One for every 10, but no fewer than one.
 - 3. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
 - 4. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than one.
 - 5. Screwdrivers for Tamper-Resistant Screws: Two of each type of screw.
 - 6. Extra Keys for Locking Switches: Two of each type.
 - 7. Extra Surge Protection Receptacles: Two of each type.
 - 8. Extra GFC Protection Receptacles: Two of each type.
 - 9. Extra Wall Plates: One of each style, size, and finish.

1.07 INFORMATION SUBMITTALS

- A. Submit field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Data: For wiring devices to include in all manufacturer's packing label warnings and instruction manuals that include labeling conditions.

1.09 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.
- C. Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated for all wiring devices.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space, in original manufacturer's packaging until ready for installation.

1.11 COORDINATION

- A. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other Sections or by others.
- B. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
- C. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
- D. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
- E. Notify Owner's Representative of any conflicts or deviations from the Contract Documents to obtain direction prior to proceeding with work.
- F. Do not install wiring devices until final surface finishes and painting are complete.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com
- B. Leviton Manufacturing Company, Inc.: www.leviton.com
- C. Pass & Seymour, a brand of Legrand North America, Inc.: www.legrand.us
- D. Cooper Wiring Devices: www.cooperwiringdevices.com

2.02 APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather-resistant GFCI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI receptacles for all receptacles installed within 6-feet of sinks.
- E. Provide GFCI receptacles for all receptacles installed in kitchens.
- F. Provide GFCI receptacles for all receptacles serving electric drinking fountains.
- G. Provide GFCI receptacles for all receptacles serving vending machines.
- H. Provide GFCI receptacles in all restrooms/bathrooms located in both commercial and residential.
- I. Provide GFCI receptacles for all receptacles in Commercial Garages, Repair and/or Storage per Article 511 of the National Electrical Code (NEC).
- J. Unless noted otherwise, do not use combination switch/receptacle devices.

2.03 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with the requirements of this Section.
- D. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: match plug configurations.
 - 2. Cord and Plug Sets: match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from a single source from a single manufacturer.

2.04 APPROVED PRODUCTS

DEVICE	LEVITON	HUBBELL	COOPER
1-POLE SWITCH	CSB1-20	1221	2221
3-WAY SWITCH	CSB3-20	1223	2223
4-WAY SWITCH	CSB4-20	1224	2224
DUPLEX RECEPTACLE	5362	5362	CR5362
DUPLEX GFCI RECEPTACLE	8899	GF5362	VGF20
DUPLEX TAMPER-RESISTANT RECEPTACLE	8200SG	GFR5362TR	TR8300

2.05 WALL SWITCHES

- A. Comply with NEMA WD 1, NEMA WD 6, UL 20, and FS W-S-896.
- B. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts; types as indicated on the Drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Switches: 120/277 V, 20 amp rated, in the following configurations:
 - 1. Single Pole.
 - 2. Two Pole.
 - 3. Three Way.
 - 4. Four Way.
 - 5. Pilot-Light.
 - 6. Key-Operated.
 - 7. Single-Pole, Double-Throw, Momentary-Contact, Center-Off: for use with mechanically held lighting contactors.
 - 8. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-Off: for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.06 STRAIGHT-BLADE RECEPTACLES

- A. All Receptacles: Self-grounding, complying with NEMA WD 1, and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the Drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring, and with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.

- B. Single Receptacles: Heavy duty, grounding type, complying with NEMA WD 1 and WD 6.
 - 1. Ratings: Match branch circuit and load characteristics.
- C. Duplex Receptacles: Heavy duty, specification grade, 20-ampere grounding type, 125 V, complying with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and FS W-C-596.
 - 1. One piece integral all brass mounting strap with back wired grounding terminal.
 - 2. Back and side wired conductor terminals.
 - 3. External wiring clamps with #10 large head brass screws.
 - 4. NEMA Configuration: 5-20R.
- D. Hospital-Grade Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and FS W-C-596.
- E. Isolated Ground Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Description: straight-blade, equipment grounding contacts shall be concealed only to the green grounding screw terminal of the device and with inherent electrical isolation from the mounting strap. Isolation shall be integral to the receptacle construction and not dependent on removable parts.
- F. Tamper-Resistant Duplex Convenience Receptacles: 25 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Description: Labeled and complying with NFPA 70, "Health Care Facilities", Article "Pediatric Locations" Section.

2.07 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12 V DC, 2.0 A, USB Type A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
 - 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 - 2. USB Receptacles: Dual, Type A.
 - 3. Line Voltage Receptacles: Dual, two-pole, three-wire, and self-grounding.
- B. Hospital-Grade, USB Charger Receptacles: 12 V DC, 2.0 A, USB Type A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
 - 1. Description: Labeled and complying with NFPA 70, "Health Care Facilities", Article "Pediatric Locations" Section.
 - 2. USB Receptacles: Dual, Type A.
 - 3. Line Voltage Receptacles: Dual, two-pole, three-wire, and self-grounding.

2.08 GFCI RECEPTACLES

- A. General Description:
 - 1. 125 V, 20 A, straight-blade, feed-through type.
 - 2. Comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

2.09 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Comply with NEMA FB 11 and UL 1010.

2.10 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration L5-20R or as specified on the Drawings, and UL 498.
- B. Twist-Lock, Isolated-Ground, Single Convenience Receptacles: 125 V, 20A; comply with NEMA WD 1 and WD 6, configuration L5-20R or as specified on the Drawings, and UL 498.
 - 1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from the mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.11 DECORATOR-STYLE DEVICES

- A. Convenience Receptacles: Square-face, 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, and UL 498.
- B. Tamper-Resistant Convenience Receptacles: Square-face, 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, and UL 498.
 - 1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- C. Weather-Resistant Convenience Receptacles: Square-face, 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, and UL 498.
- D. GFCI Feed-Through Type, Convenience Receptacles: Square-face, 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and UL 943 Class A.
- E. GFCI, Tamper-Resistant Convenience Receptacles: Square-face, 125 V, 20 A; comply with NEMA WD 1 and WD 6, configuration 5-20R, UL 498, and UL 943 Class A.

1. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- F. Toggle Switches: Square-face, 120/277 V, 20 A; comply with NEMA WD 1, UL 20, and FS W-S-896.
 1. Toggle switches for motor duty shall be rated at minimum 2HP at 277V, 1HP at 120V.
- G. Lighted Toggle Switches: Square-face, 120/277 V, 20 A; comply with NEMA WD 1, and UL 20.
 1. Description: with LED-lighted handle, illuminated when switch is off.

2.12 WALL SWITCH SENSOR LIGHT SWITCH, DUAL-TECHNOLOGY

- A. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual-technology.
 1. Connections:
 - a. Provisions for connection to BAS.
 - b. Hard wired.
 - c. Wireless.
 2. Rated 960 W at 120 VAC for tungsten lighting, 10 A at 120/277 VAC for fluorescent or LED lighting, and 1/4 hP at 120 VAC.
 3. Integral relay for connection to BAS.
 4. Adjustable time delay; 5, 10, 15, or 20 minutes and set at 20 minutes.
 5. Able to be locked to Automatic-On or Manual-On mode.
 6. Automatic Light-Level Sensor: Adjustable from 2 to 200 footcandles.
 7. Comply with NEMA WD 1, UL 2, and FS W-S-896.

2.13 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: White, or as selected by the Architect, or as otherwise indicated.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. SPD Devices: Blue.
 4. Isolated-Ground Receptacles: Orange or with Orange triangle on face.
- B. Cover Plate Color: For plastic covers, match device color, otherwise 302 stainless steel.

2.14 STAND-ALONE FIRE ALARM SMOKE DETECTION AND COMBINATION SMOKE/CO DETECTION

- A. Electrical Contractor to include 120V stand-alone fire alarm smoke detectors with 9V battery backup in all sleeping rooms or as required by Authority Having Jurisdiction, NFPA 72 - National Fire Alarm Code and Signaling Code, NFPA 101 - Safety to Life from Fire in Buildings, and local codes.

- B. Electrical Contractor to include 120V stand-alone fire alarm combination smoke/CO detectors with 9V battery backup in outside of sleeping rooms, and each level or as required by Authority Having Jurisdiction, NFPA 72 - National Fire Alarm Code and Signaling Code, NFPA 101 - Safety to Life from Fire in Buildings, and local codes. If a hall or area is more than 30 feet long, install a unit at each end.
- C. Electrical Contractor to make sure that no 120V stand-alone fire alarm smoke or combination smoke/CO detectors is within 10-feet of the kitchen range and microwave as required by Authority Having Jurisdiction, NFPA 72 - National Fire Alarm Code and Signaling Code, NFPA 101 - Safety to Life from Fire in Buildings, and local codes.
- D. Electrical Contractor to provide a dedicated circuit with a lock on device on the circuit breaker for these detectors. Label circuit breaker "FA UNIT SMOKE/CO".
- E. Provide tandem wiring between each 120V stand-alone smoke detector in a single dwelling unit. So that if any one smoke detector in the dwelling unit is triggered all other smoke detectors will alarm with that dwelling unit.
- F. MANUFACTURERS
 - 1. BRK Electronics: www.brkelectronics.com
 - 2. Kidde: www.kidde.com
 - 3. Gentex: www.gentex.com
 - 4. Or other reviewed and approved Manufacturers.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Device or equipment mounting height given herein in the Specifications, Drawings, and/or Contract Documents, are intended to provide general guidelines pursuant to industry standards. Such guidelines may not be exact or accurate and may or may not conflict with other trades installation without verification. Provide field coordination and verification with other divisions.
 - 1. Verify counter heights with cabinet installer and cabinet shop drawings, prior to rough-in for outlets.
 - 2. Examine other trades shop drawings to ensure that such mounting heights are appropriate for the intended device use, and the device locations do not conflict with other components. Immediately report impaired device use and conflict/location to the Owner's Representative for resolution. Devices may be moved up to 20-feet without additional compensation.
 - 3. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that final surface finishes are complete, including painting.

1. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.
- C. The Drawings are diagrammatic and indicate generally the locations of materials, equipment, and devices. These Drawings shall be followed as closely as possible.
 1. Coordinate the work under this Section with the Architectural, Structural, Plumbing, Heating and Air-Conditioning, and the drawings of other trades for exact dimensions, clearances, and roughing-in locations.
 2. Cooperate with other trades in order to make minor field adjustments to accommodate the work of others.
 3. Devices and outlets can be field located by Owner's Representative within 20-feet of the designed locations prior to rough-in work, without extra compensation.

3.03 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint, unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing conductors (where applicable):

- a. Cut back and pigtail.
 - b. Replace all damaged conductors.
 - c. Straighten conductors that remain and remove corrosion and foreign matter.
 - d. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- E. Install wall switches with OFF position down.
- F. Install two or more wiring devices shown in one location under a common cover plate. Install cover plates with edges in continuous contact with finished wall surfaces. Do not install more than one device in a single gang position.
- G. Before installation rough-in, device locations may be revised by the Owner's Representative within 20-feet of the designed contract location, at no additional cost.
- H. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package, or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6-inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3s to 3/4s of the way around the terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-amp circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device(s).
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in the yokes, allowing metal-to-metal contact.
- I. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles at the bottom, and on horizontally mounted receptacles to the right.
 - 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- J. Device Cover 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.

- K. Cover Plate Gaskets: Place gasket over exposed outlet boxes flush with wall surface with device protruding through precut opening in seal. Fit cover plate over gasket and hold in place with plate-securing screws.
- L. Dimmer Switches:
 - 1. Install dimmer switches within terms of their listing.
 - 2. Verify that dimmer switches used for fan-speed control are listed for that application.
 - 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturer's device listing conditions in the written instructions.
- M. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multi-gang cover plates.
- N. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.04 GFCI RECEPTACLES

- A. Install non-feed through-type GFCI receptacles where protection of downstream receptacles are not required.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Division 01.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, dimmer switch, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test Instruments: Use instruments that comply with UL 1436.
- F. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital display indicators of measurement.
- G. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-amp 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.
- H. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding-blade according to NFPA 99. Retention force shall not be less than 4 oz.
- I. Wiring devices will be considered defective if they do not pass tests and inspections.
- J. Correct wiring deficiencies and replace damaged or defective wiring devices.
- K. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust devices and cover plates to be flush and level.

3.07 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems".
- B. Identify each receptacle with panelboard and circuit number identification. Use hot, stamped, or engraved machine printing with black-filled lettering on face of cover plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Furnish and install fuses having the electrical characteristics, ratings, and modifications as specified herein and as shown on the Drawings.

1.03 RELATED SECTIONS

- A. Division 26 Section "Identification for Electrical Systems".
- B. Division 26 Section "Enclosed Switches".

1.04 REFERENCES

- A. NEMA FU 1 – Low-Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002 (R 2007).
- B. NFPA 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by the Authority Having Jurisdiction, including all applicable amendments and supplements.
- C. UL 248-1 – Low-Voltage Fuses – Part 1: General Requirements; Current Edition, including all revisions.

1.05 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Submit catalog cuts for all items proposed to be furnished and installed under this Section.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Bussman by Eaton:
<http://www.cooperindustries.com/content/public/en/products/fuses.html>
- B. Or other reviewed and approved Manufacturers.

2.02 FUSES

- A. Comply with UL 248-1.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- D. Provide fuses of the same type, rating, and manufacturer within the same disconnect switch.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for the installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Provide fuses for equipment containing fuse-holders, including equipment furnished by other Divisions. Size motor branch circuit fuses in accordance with the rating of the motor served. Size fuses for equipment circuits in accordance with the branch circuit rating.
- C. Install fuses with label oriented such that manufacturer, type, and size are easily able to be read.

- D. Provide duplicate sets (3 fuses per set) of spare fuses of each type and rating at the completion of the Project.
- E. Provide spare fuses and fuse cabinet installed at location directed by Owner.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Furnish and installed the Enclosed Safety Switches having the electrical characteristics, ratings, and modifications as specified herein and as shown on the Drawings.

1.03 RELATED SECTIONS

- A. Division 26 Section "Grounding and Bonding".
- B. Division 26 Section "Identification for Electrical Systems".
- C. Division 26 Section "Fuses".
- D. Division 26 Section "Hangers and Supports for Electrical Systems".

1.04 REFERENCES

- A. NECA 1 – Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- B. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
- C. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R 2006).
- D. NETA STD ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

- E. NFPA 70 – National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, including all applicable amendments and supplements.
- F. UL 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, including all revisions.
- G. UL 50E – Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, including all revisions.
- H. UL 98 – Enclosed and Dead-Front Switches; Current Edition, including all revisions.

1.05 SUBMITTALS

- A. Submit under Provisions of Division 01.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of installed enclosed switches.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of the manufacturer's instructions shall be included with the equipment at time of shipment.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Cutler-Hammer.
- B. Siemens.
- C. Square D (Schneider Electric).
- D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer and Owner.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break, enclosed safety switches complying with NEMA KS 1, type HD (heavy duty), and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the Drawings.
- B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,000 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 deg C) and 104 degrees F (40 deg C).
- D. Horsepower Rating: Suitable for connected load(s).
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short-Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by fuses or supply side overcurrent protective devices to be installed, with listed short-circuit current rating (SCCR) not less than the available fault current at the installed location as indicated on the Drawings.
 - 2. Minimum Ratings: 18k AIC.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide insulated, groundable, fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA ICS 6, NEMA KS 1 and NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: NEMA-1.
 - b. Indoor Dirty/Dusty, Dry Locations: NEMA-12.
 - c. Outdoor and Indoor Wet Locations: NEMA-3R.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

- N. Heavy-Duty Switches:
 - 1. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
- O. Switches shall be equipped with the number of poles, voltage and current rating required for the equipment being served.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches in accordance with the manufacturer's instructions.
- B. Install enclosed safety switches securely, in a neat workmanlike manner and in accordance with NECA-1.
- C. Arrange equipment to provide minimum clearances in accordance with the manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29 "Hangers and Supports for Electrical Systems".
- E. Install enclosed switches level and plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79-inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26 "Grounding and Bonding".
- H. Provide fuses complying with Section 26 28 13 "Fuses" for fusible switches as indicated or as required by the equipment manufacturer's recommendations.
- I. Provide identification nameplate for enclosed switches in accordance with Section 26 05 53 "Identification for Electrical Systems".
- J. Provide identification label on inside door of each fused switch indicating NEMA fuse class, rating, and size. Install label in accordance with Section 26 05 53 "Identification for Electrical Systems".
- K. Provide arc flash warning labels in accordance with NFPA 70E.

- L. Provide disconnect switches as indicated on the Drawings, Schedules, at motors, motor driven equipment, motor controllers, electric heating equipment, appliances, and other equipment, unless the equipment has self-contained, code approved disconnecting method.
- M. Mounting: Coordinate mounting location with equipment installation Contractor. In general, mounting height shall be 72-inches, maximum to top of switch.

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Division 01.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.03 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.04 CLEANING

- A. Clean dirt and debris from switch enclosure and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 31 00

SOLAR PHOTOVOLTAIC UTILITY GRID-TIED SYSTEMS

PART 1 - GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01 and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. The Contractor shall design, furnish, and install the complete Solar Photovoltaic (PV) Grid-Tied System as described herein and where shown on the Drawings.
- B. The Contractor shall adhere to the State of Washington General Conditions and Supplementary Instructions in Division 01 of the Contract Documents.
- C. This Section Includes: Solar photovoltaic (PV) utility grid-tied system including the following:
 - 1. Roof mounted solar modules.
 - 2. AC/DC inverters.
 - 3. Disconnect switches.
 - 4. Overcurrent protection.
 - 5. Connections to AC distribution system.
 - 6. Metering equipment.
 - 7. Application of service.
 - 8. Coordination with utility.
 - 9. Environmental and PV modules performance sensors.
 - 10. Web-based software program with graphics.
- D. The system shall supply power to the Owner's electrical distribution system. The system shall not exceed the inverter's maximum input voltage.
- E. Provide complete solar photovoltaic system for each project site. Provide all required interconnecting cables, AC and DC disconnect switches, combiner boxes, branch circuits, solar PV panels (modules), metering equipment, PV

mounting hardware (PV mounting rails, tilt support legs, cross braces, support rails, seismic supports, mounting clips, brackets, environmental panel monitoring system (temperature, wind, solar irradiance), roof mounting standoffs, raceway and conductors, PV module power performance sensors, data acquisition and remote monitoring hardware and software, and utility grid-tie interconnection.

1. Terry's Corner Driver Facility: Total system size shall be 2.85 kW DC.
- F. Systems must be designed and installed using UL or ETL listed components, including mounting systems.

1.03 RELATED SECTIONS

- A. Division 26 Section "Grounding and Bonding".
- B. Division 26 Section "Raceways and Boxes".
- C. Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

1.04 STANDARDS

- A. It is the intent of these Specifications to ensure the PV system installed adheres to any and all of the following.
 1. Washington State Building Codes and Standards.
 2. Washington State Solar Initiative Program.
 3. Applicable utility rules and tariffs.
 4. Any and all technical and installation specifications and guidelines recommended by the manufacturers.

1.05 REFERENCE STANDARDS

- A. The systems shall be designed in accordance with applicable portions of the following standards:
 1. ANSI C62.41.1 (American National Standards Institute): IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 2. ANSI C62.41.2 (American National Standards Institute): IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
 3. IEEE 519 (Institute of Electrical and Electronic Engineers): IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 4. IEEE 929-2000 (Institute of Electrical and Electronic Engineers): Recommended Practice for Utility Interface of Photovoltaic Systems.

5. NEC 2023 (National Fire Protection Association): National Electrical Code.
6. UL 1703 (Underwriters Laboratories Inc.): Flat-Plate Photovoltaic Modules and Panels.
7. UL 1741 (Underwriters Laboratories Inc.): Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.
8. FCC Part 15 A and B (Federal Communications Commission).

1.06 DEFINITIONS

- A. IP Code: Required ingress protection to comply with IEC 60529.
- B. MPPT: Maximum power point tracking.
- C. PV: Photovoltaic.
- D. STC: Standard Test Conditions defined in IEC 61215.

1.07 ADMINISTRATION REQUIREMENTS

- A. Physical layout shall be coordinated and signed off on by structural engineer of record.
 1. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 2. Provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 3. Notify Owner's Representative and Electrical Engineer of any conflicts with or deviation from the contract documents. Obtain direction prior to proceeding with work.
- B. Utility Interconnection:
 1. Assist in preparing and submitting documentation as required for securing utility interconnection agreement between Owner and serving utility.
 2. Coordinate with utility to provide net metering and production metering suitable for system requirements.

1.08 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. The manufacturer of the components for the system shall be a United States based manufacturer with a minimum of 5-years of documented experience in the design and fabrication of photovoltaic panels and inverters.

- C. The designing and installing Contractor shall have installed similar type photovoltaic systems for a minimum of 5-years as a principal business, not just occasionally.
- D. The foremen and journeymen electricians and installers shall have received adequate training and are trained in the installation of photovoltaic systems. The Contractor shall provide documentation that this requirement is met.
- E. The designer of the shop drawings shall have a minimum of 5-years' experience designing solar voltaic arrays for commercial installations. The designer shall have designed at least two successful commercial installations within the last 10-years. Please submit project name, location, and client point of contact.
 - 1. Installer to be North American Board of Certified Energy Practitioners certified and have 2-years of experience installing photovoltaic systems.

1.09 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing work of this Section. Discuss installation procedures of equipment, connection points of equipment to building infrastructure, and safety procedures of installation and post-installation work, hazards of solar array systems, and procedures if accidental contact of solar arrays occur.
- B. Provide a schedule, indicating installation tasks, time duration for each task, and coordination items to be discussed at least five days prior to the meeting to the Owner's Representative. Within the project schedule, include milestone dates for equipment installation, testing, and energizing of equipment durations.

1.10 SUBMITTALS

- A. Prepare and submit all information required for plan review and permitting by authorities having jurisdiction.
- B. Product Data: Submit product data for the PV system to be installed, including model numbers, types, dimensions, weights, kW, kVAR, currents, voltages, locations, required clearances, and other data shown for the items listed below:
 - 1. Roof mounted solar panels.
 - 2. Photovoltaic Inverters: Include short-circuit capabilities.
 - 3. Combiner Panels/Boxes.
 - 4. DC Disconnect Switches: Include interrupting rating.
 - 5. AC Disconnect Switches: Include interrupting rating.
 - 6. Fuses: Include voltage, amperes, and interrupting ratings.
 - 7. Utility meter and base (if required).
 - 8. Circuit Breakers: Include types, frames, and trip ratings.

9. Environmental panel monitoring system.
10. Web based software program loaded on a remote computer.
- C. Qualifications:
 1. Manufacturer.
 2. Designer.
 3. Installing Contractor.
 4. Foremen and Electricians (installers).
- D. Shop Drawings:
 1. The Contractor shall develop shop drawings detailing the layout of solar panels, structural details including connections to the building, roof penetrations, wiring of solar panels, routing of wiring and raceway runs, locations and elevations of inverters, combiner panels/boxes, and connections to the main switchboard. The shop drawings shall be a minimum of 1/8 inch scale.
- E. Design Data:
 1. Include structural calculations, certified by structural engineer, for equipment and mounting system. Submit to Owner's Representative for review.
- F. Samples:
 1. For roof mounted solar panels including frame, rails, mounting hardware, and exposed accessories to review materials, finishes, and profile of assembly prior to installation.
 2. Samples may be used for final installation with Owner's written approval.
- G. The Contractor shall furnish two (2) equipment submittal copies. Submittals shall be specific for the equipment furnished and shall include as-built information.
- H. The Contractor shall complete and submit an application to the serving utility as well as the City for the PV system. Include appropriate documentation as indicated in utility's application. Please copy all correspondence to the Owner and Engineer.
- I. Commissioning: Submit equipment manufacturer's installation, startup, and testing procedures for approval by the Owner's Representative after approval of connection from the serving Utility. At minimum, this documentation must include the following items:
 1. All required equipment components that will be provided and installed.
 2. All equipment components are clean and free of any damage.

3. All equipment control and power wiring connections are complete, verified, and recorded.
 4. All equipment components which require adjustment, calibration, are recorded.
 5. All equipment components amperes, voltages are recorded for each phase.
 6. All equipment components proper operation shall be verified and recorded.
 7. Performance figures are recorded and compared to expected baseline.
 8. All necessary warranty information is recorded and submitted.
 9. Maintenance access and provisions are provided with easy access.
 10. Equipment performs operational service without failures or interruptions.
 11. Equipment and components perform as specified.
 12. Equipment recovers cleanly from power failure and resumes normal operation.
 13. All operational modes of equipment are functional.
 14. Equipment components operate without excessive heat or noise.
 15. Equipment components are operating with smooth action and accuracy.
- J. Training: At least 1-month prior to scheduled training, submit training session agendas for approval by the Owner's Representative.

1.11 WARRANTY

- A. The manufacturer shall guarantee the system(s) to be free from material defects and workmanship for a period of 1-year from date of completed installation. Manufacturer agrees to repair or replace components of PV modules that fail in materials or workmanship within specified warranty period.
- B. The solar panels shall have the following power output warranty:
 1. 10-years at 90-percent minimum output.
 2. Remaining 15-years at 80-percent minimum output.
- C. AC/DC power inverters shall have a minimum of 10-year warranty.
- D. Power optimizers shall have a minimum of 25-year warranty.

PART 2 - PRODUCTS

2.01 PHOTOVOLTAIC MANUFACTURERS

- A. Manufacturers:
 - 1. Basis of Design: Q.Peak Duo XL-G11
- B. Description:
 - 1. Shall be NEC 2023 compliant.
 - 2. Shall be UL listed to 1000 V DC.
 - 3. Shall meet IEC 61646 requirements.

2.02 AC/DC INVERTERS

- A. Manufacturers:
 - 1. Manufacturer to be listed on California Energy Commission Solar Equipment List.
 - 2. Basis of Design:
 - a. Terry's Corner Driver Facility: SolarEdge SE3800H-US.
- B. The inverters shall utilize sine-wave technology and high frequency PWM.
- C. Inverter Specifications:
 - 1. AC Input Frequency: 60 Hz.
 - 2. Peak Efficiency: 95-percent, minimum.
 - 3. UL 1741 / IEEE 1547 Listed.
 - 4. AC Output Voltage:
 - a. Terry's Corner Driver Facility: 208V, 1-phase.
 - 5. Enclosure: NEMA 250, Type 3R.
- D. Ground fault detection shall be incorporated with automatic shutdown of more than one (1) amp.
- E. Automatic disconnect upon utility power outage shall be integral to the unit and system.
- F. Provide with LCD display, RS-485 communications, integrated web server for remote online access to all current data from any PC for data storage.
- G. Provide size and quantity of inverters necessary to achieve maximum performance and accommodate the PV arrays.

2.03 COMBINER PANELS/BOXES

- A. Fuse disconnecting means for PV array strings (circuits).
- B. Meet UL 1741 Standard. Self-certification is not acceptable.
- C. Array combiner fuse types shall contain Class R fuses in a maximum of six (6) string (circuit) configurations, 1000 V DC rated continuous duty.
- D. Source combiner to contain touch-safe midget class fuse holders, rated for 1000 V DC continuous duty. Maximum of 24 string (circuit) configuration.
- E. Provide with NEMA-3R enclosure, cabinet style with pad lockable latch, and continuous hinged door.
- F. Provide quantities as required to accommodate the total quantity of PV arrays.

2.04 SOLAR AC DISCONNECT

- A. Refer to and comply with Section 26 28 16 "Enclosed Switches".

2.05 UTILITY METER AND BASE

- A. Comply with serving electrical utility company and coordinate all requirements
 - 1. Terry's Corner Driver Facility: Snohomish County PUD (SnoPUD).
- B. When required by serving Utility, provide utility meter, base, and relaying equipment to allow connection of solar photovoltaic system to the Utility's grid. Metering shall be Net-Metering per the serving Utility's standards.

2.06 MONITORING

- A. Provide monitoring system compatible with AC/DC Inverter System interface. The system shall include the following as minimum requirements:
 - 1. Web-based views of how the solar electric system is working.
 - 2. Automatic calculation on the reduction of green-house gas emissions.
 - 3. Provide system IP address to allow remote display with web-based views.

2.07 MOUNTING SYSTEM

- A. Manufacturers:
 - 1. Unirac MetalX
 - 2. S-5!
 - 3. Or Approved Equal
- B. Mounting Structures:
 - 1. Roof mount: Extruded aluminum

2. Panel frame and accessories exposed to view shall be matte finish, dark or black color.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until mounting surfaces have been properly prepared.
- B. If preparation of mounting surfaces is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding.
- C. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- D. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of PV panels with roof assembly and other construction.
- C. The systems wiring, components, raceways, and connections must be suitable for conditions for which they are to be installed. An internal data meter must be installed to measure the AC output of the inverter(s). This meter should be located in a location accessible to facilities personnel.
- D. Install weatherseal fittings and flanges where PV panel assemblies penetrate exterior elements such as walls or roofs. Seal around openings to make weathertight. Seal joints as recommended by the manufacturer of the metal roof system as not to void the roofing manufacturer's warranty
- E. Interconnection must comply with the serving Utility, and their PV interconnection standards. The Contractor shall assist the Owner in preparing and submitting the appropriate interconnection agreements with the serving Utility. This shall be done at no cost or liability to the Owner.
- F. Solar Panel Module Mounting: Panels shall be mounted to the roofing system with the least required roof standoffs. Provide a Structural Engineer Certification that the new solar PV system mounting and racking support system is rated to meet the local seismic zone, wind speeds, and snow loads. The system shall be compatible with the roofing type and shall not void the manufacturer's roofing warranty.

- G. Provide markings for all interior and exterior direct-current raceways, enclosures, cable assemblies, combiner boxes, disconnects, and inverters per 2018 International Fire Code (IFC) 1204 and 2023 National Electrical Code (NEC).
- H. A 4-foot-wide clear path of travel must be maintained to all rooftop equipment. A 6-foot-wide clear perimeter must be maintained around the edges of the roof. Where either axis of the building is 250 feet or less, the clear perimeter around the edges of the roof shall be permitted to be reduced to a minimum width of 4-feet. Adjust this requirement per Fire Marshal's direction.
- I. Coordinate and attend a meeting with the Fire Marshall. Provide drawings incorporating final agreed Fire Marshal comments.
- J. If required, attend meeting(s) with the serving Utility and coordinate metering requirements and location of disconnecting means.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Furnish the Manufacturer's Representative services specified in Article titled "Commissioning" of this Section.

3.04 ELECTRICAL CONNECTIONS TO ELECTRICAL DISTRIBUTION SYSTEM

- A. Contractor is responsible for all labor, materials, and installation up to the building electrical distribution system connection point. The Contractor shall provide the final connections to the electrical distribution system.

3.05 GROUNDING

- A. Grounding shall be as required in NEC Section 690, part V.
- B. Provide all equipment grounding and grounding electrodes in accordance with NEC 2020, Section 690.
- C. Provide grounding of equipment frames with copper bonding conductors per NEC 690.43(C).

3.06 LABELLING

- A. Provide and install all required safety and warning labels per NFPA, NEC, local and State codes, and per AHJ.
- B. Provide and install "Warning" and "Shock Hazards" labels to all inverters.

3.07 COMMISSIONING

- A. The Manufacturer's Representative shall perform and document the installation verification, startup, and testing. Refer to the following for additional requirements.
- B. Only the Owner's Representative and Manufacturer's Representative can approve of the installation, startup, and testing procedures. These shall be

acceptable for use during the required documenting of the installation verification, startup, and testing procedures.

- C. Provide all calibration and testing instrumentation to successfully and properly install, startup, and test equipment. Ensure all calibration and testing instrumentation has been calibrated by NIST traceable or equivalent calibration certificate within one year of use.
- D. Provide a minimum of 2-weeks' notice to the Manufacturer's Representative, and Owner's Representative, prior to the scheduled installation, verification, startup, and testing.
- E. Provide site coordination to ensure equipment testing is not impacted by other site work. The Contractor shall ensure the equipment is in proper working order for the scheduled startup and/or testing.
- F. Any issues or deficiencies discovered during testing that impact operational demonstration shall require retesting in order to properly demonstrated equipment operation upon issue/deficiency resolution at no additional cost to the Owner.

3.08 DEMONSTRATION AND TRAINING

- A. Furnish two (2) 4-hour training sessions of instruction periods, each for minimum of four (4) people, to be conducted at the Project site. Part of the instruction shall include the procedures to shut down the solar PV system in the event of an emergency. The Contractor shall insure that Owner's personnel and the Fire Department can easily identify what to do in the event of an emergency and can be able to perform these tasks quickly and safely. Instruction shall also include operation of the monitoring system. Provide a minimum of 2-weeks' notice of the scheduled training session.

3.09 OPERATION AND MAINTENANCE

- A. Provide O&M Manuals per Division 01 requirements. O&M Manuals shall include step by step instructions on operations manuals on how to shut down the solar PV system in the event of an emergency.
- B. The Contractor shall provide a contact website and phone number for technical assistance. Provide reports from monitoring system to demonstrate the system is fully operational.

END OF SECTION

SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. This Section includes the following types of LED luminaires:
 - 1. Downlight.
 - 2. Surface mount linear.
 - 3. Suspended linear.
 - 4. Materials.
 - 5. Finishes.
 - 6. Luminaire supports.

1.03 DEFINITIONS

- A. CCT: Correlated Color Temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: Refer to "Luminaire".
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-Emitting Diode.
- F. Lumen: Measured output of lamp and/or luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp(s), reflector, and housing.

1.04 SUBMITTALS

- A. Product Data Sheets: For each type of product, arranged by designation.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations as indicated on the Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from the installers of the items involved.
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer(s).
- C. Product Certificates: For each type of luminaire.
- D. Sample warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.07 WARRANTY

- A. Warranty: Manufacturer and Installer shall agree to repair or replace components of luminaires that fail in materials and workmanship within specified warranty period.
- B. Warranty Period: Five (5) years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 1. Luminaires shall withstand the effects of earthquake motions determined according to ASCE 7.
 - a. The term “withstand” means “the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified.
 2. Luminaires and lamps shall be labeled vibration and shock resistant.

2.02 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. Standards:
 - 1. ENERGY STAR certified.
 - 2. California Title 24 compliant.
 - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 - 5. UL Listing: Listed for damp locations, unless otherwise indicated.
 - 6. Recessed luminaires shall comply with NEMA LE 4.
- C. CRI of minimum 80. CCT of 3500 K.
- D. Rated lamp life of 35,000 hours to L70.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 VAC, unless otherwise indicated in the Lighting Fixture Schedule.
- H. Lens Thickness: At least 0.125 inch minimum, unless otherwise indicated.
- I. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear powder-coat finish.

2.03 DOWNLIGHT

- A. Lumens as indicated in the Lighting Fixture Schedule. Minimum allowable efficacy of 90 lumens per watt.
- B. Universal mounting bracket.
- C. Integral junction box with conduit fittings.
- D. Optics:
 - 1. Fixed lens.
 - 2. Light distribution as indicated in the Lighting Fixture Schedule.

2.04 SURFACE MOUNT LINEAR

- A. Lumens as indicated in the Lighting Fixture Schedule. Minimum allowable efficacy of 90 lumens per watt.

- B. Integral junction box with conduit fittings.

2.05 SUSPENDED LINEAR

- A. Lumens as indicated in the Lighting Fixture Schedule. Minimum allowable efficacy of 85 lumens per watt.
- A. Integral junction box with conduit fittings.

2.06 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners/edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. For and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without the use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers:
 - 1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded aluminum housing and heat sink.
 - 2. Clear powder-coat finish.

2.07 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.

2.08 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and for nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish shall be the same as the luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- F. Special fittings identified for use in horticultural lighting shall be designed specifically for the horticultural lighting equipment on which they are to be installed.

PART 3 – EXECUTION

3.01 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: Sized and rated for luminaire weight.
- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 20-gauge backing plate, attached to wall structural members.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support: Ceiling mount as indicated in the Lighting Fixture Schedule.
- H. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48-inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".

- J. Identify system components, wiring, cabling, and terminals as required in Section 26 05 53 "Identification for Electrical Systems".

3.02 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 of emergency power for emergency light fixtures. 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.

END OF SECTION

SECTION 26 56 19

EXTERIOR LIGHTING

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, and Division 26.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. This Section includes the following types of LED luminaires:
 - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Materials.
 - 4. Finishes.

1.03 RELATED WORK

- A. Specified Elsewhere: Drawings and general provisions of the Contract apply to this Section.
- B. Section 26 09 23 "Lighting Control System" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.

1.04 SYSTEM DESCRIPTION

- A. Section Includes:
 - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Luminaire mounted photoelectric relays.

1.05 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experiences and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by the manufacturer(s).

1.06 REGULATORY REQUIREMENTS

- A. National Electrical Code 2017 (NFPA 70).

1.07 ABBREVIATIONS AND 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(s), reflector, and housing.

1.08 SUBMITTALS

- A. Product Data: For each type of luminaire:
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with IES lighting measurements and test and calculation guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaires as applied in this Project.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for energy efficient lighting products.

- b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - 6. Wiring diagrams for power, control, and signal wiring.
 - 7. Photoelectric relays.
 - 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Product Schedule: For luminaire and lamps.
- C. Delegated Design Submittal: For luminaire supports.
- 1. Include design calculations for luminaire supports.

1.09 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. Luminaires.
 - 2. Structural members to which equipment and luminaires will be attached.
 - 3. Underground utilities and structures.
 - 4. Existing underground utilities and structures.
 - 5. Above grade utilities and structures.
 - 6. Existing above grade utilities and structures.
 - 7. Building features.
 - 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer(s):
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
- 1. Luminaire.
 - 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- F. Source quality control reports.

- G. Sample warranty.

1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.11 OPERATION AND MAINTENANCE 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. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 10 of each type and ratings installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 10 of each type and ratings installed. Furnish at least one of each type.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.13 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.14 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within the specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 5 years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term “withstand” means “the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified”.

2.02 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for the intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by and NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 80, CCT of 3500 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: Refer to drawings.
- L. Lamp Rating: Lamp marked for outdoor use.
- M. Source Limitations: Obtain luminaires from single source from a single manufacturer. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.03 LUMINAIRE MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.

- B. Contact Relays: Factory mounted, single throw, designed to fail in the ON position, and factory set to turn light on at 1.5 to 3 fc and off at 4.5 to 10 fc with a 15-second minimum time delay.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on/off set points.

2.04 LUMINAIRE TYPES

- A. Refer to Drawings.

2.05 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: For and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without the use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in the operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located 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 for all luminaires.

2.06 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. 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.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and –tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: Black.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build, polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of manufacturer's standard color.
 - c. Color: As selected by Architect from manufacturer's full range.

2.07 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 – EXECUTION

3.01 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 electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, canopy ceilings, and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by the manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 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.
- F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.04 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems". In concrete foundations, wrap conduit with 0.010 inch thick, pipe wrapping plastic tape applied with a 50 percent overlap.

3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems".

3.06 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. 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. Verify operation of photoelectric controls.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to the lighting system, retest to demonstrate compliance with standards.

3.07 DEMONSTRATION

- A. Train Owner's personnel to adjust, operate, and maintain luminaires and photocell relays.

3.08 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 site 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

SECTION 27 01 00

OPERATION AND MAINTENANCE OF COMMUNICATION SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27 and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 DESCRIPTION

- A. Definition:
 - 1. "Telecommunications Cabling" as used in this Section refers to a unified cable plant primarily designed for carrying signals associated with telephone, telecommunications common carrier, data, and communications within the building. At places, interfaces occur between the telecommunications cabling system and other signal cable systems, and telecommunications systems may share cable tray and rack spaces with other systems. However, for construction purposes, the "Telecommunications Cabling" system is separate and may have different specification provisions from other systems.
 - 2. The cabling system is designed to support a universal cabling system for both voice and data. Most information outlets will consist of outlet boxes with uniform Category 6 jacks for voice and data. The size of the outlet boxes and conduit at each location are indicated in the Electrical Specifications.

1.03 SUMMARY

- A. Communications Structured Cabling System:
 - 1. The Cable Infrastructure Project requires an AMP NETCONNECT System structured cabling system. The cabling system shall be backed by Tyco Electronics 25-Year System Warranty.
 - 2. There shall be deployed two data circuits to each user outlet as a standard configuration.
 - 3. The data circuit shall be provided via two Category 6 U/UTP plenum cables. Horizontal data cables shall be terminated on rack-mounted patch panels.
 - 4. There shall be deployed one voice circuit to each user outlet as a standard configuration.
 - 5. The voice circuit shall be provided through one Category 6 U/UTP plenum cable. Horizontal voice cables shall be terminated on rack-mounted patch panels and cross-connected to the backbone riser frames within the MDF or main Telecommunication Room (TR).

6. A standard classroom shall have three (3) data jacks and a power outlet on the ceiling.
 - a. These three data jacks are for the projector, a wireless access point, and an additional device used for wireless projecting.
 - b. Two of the data jacks and the power outlets must be near/adjacent to the projector.
 - c. Typically the third data jack, used for a wireless access point, shall be terminated above the ceiling and also located near the projector.
7. A standard classroom shall have four (4) data jacks adjacent to the Teacher Work Station. (This number does not include any "Video over Cat 6" that may be run directly to the projector in the room).
8. Copper Backbone Cable: Provide a backbone cable system tested for continuity and performance, consisting of Category 3 UTP telephone riser cable.
9. Fiber Optic Backbone Cable: Provide a complete, tested, and documented backbone data cabling system consisting of multimode and singlemode fiber optic cabling, including termination shelves, connector terminations, and testing.
10. Work area cables from the multi-user outlet shall be connected directly to the work station equipment without the use of additional intermediate connections.
11. Wireless access points, patch cords, and mounting brackets will be provided by the customer but installed by the contractor. Contractor will provide as-builts or maps with exact locations of all access points and record of the room numbers, state tag numbers, jack numbers used, and serial numbers of each access point. Contractor will also submit a digital photo of the location of each access point with the documentation.

B. Contractor Requirements:

1. The low voltage cable system installer shall at a minimum be a firm normally employed in the low voltage cabling industry with a reference list of at least five (5) similar projects with contact names to confirm the successful completion of Category 6 UTP and fiber optic cable plant projects within the last twelve (12) months prior to the bid opening date of this Project. In addition, the Contractor must submit proof of Category 6 UTP and fiber optic cable test equipment training and certification for technicians that will be testing the installation. The Contractor shall discuss the Category 6 testing procedures with the Owner and Engineer prior to the beginning of testing.
2. The successful Contractor is required to furnish all labor, supervision, tooling, miscellaneous mounting hardware and consumables for each cabling system installed. The Contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Cable Infrastructure Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement, to support the 25-Year System Warranty requirements. After the installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, including test results, and to apply for said warranty on behalf of the customer. The system warranty will cover the components and labor associated with the repair/replacement of any failed link as a result of a defective product when a valid warranty claim is submitted within the warranty period.

3. The Contractor shall establish a single point of contact (POC) with the Customer who will be responsible for reporting progress and updating the Customer's technical representative with issues that the Owner must address to facilitate the cabling system installation. The Contractor's POC shall provide weekly written reports to the Customer's technical representative detailing progress. Requests for access to limited access or restricted areas shall be made 7 days prior to the required access. Information critical to the completion of the task or project shall be communicated to the Customer's technical representative as the requirement becomes known. Casual information shall be passed during the scheduled progress report.
4. The Contractor shall maintain the Customer's facility in a neat and orderly manner during the installation of the communications cabling system. The Customer's facilities shall be maintained in broom clean condition at the completion of each work day. At the completion of work in each area, the Contractor shall perform a final cleaning of debris prior to moving the installation crew to the next work area.

1.04 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
 1. None.

1.05 REGULATORY REQUIREMENTS

- A. All work shall be performed in accordance with the latest revisions of the Washington Department of Labor and Industries and the following industry standards and codes:

FCC Part 68	Connection of Terminal Equipment to Telephone Network.
Uniform Building Code	International Conference of Building Officials (ICBO); Regional Office: 126505 Bellevue-Redmond Road, Bellevue, WA 98005.
WAC-296-46	Laws, Rules, and Regulations for Installing Electric Wires and Equipment
NFPA 70 (NEC)	2017 National Electrical Code
NFPA 75	Protection of Electronic Computer and Data Processing Equipment
NFPA 78	Lightning Protection Code
NFPA 101	Life Safety Code
OSHA 29 CFR Part 1910	Occupational Safety and Health Standards
FCC Part 76.611	CFR Title 47 Radiation Leakage Standards

Governing Codes and Conflicts: If the requirements of this Section of the Project Drawings exceed those of the governing codes and regulations, then the requirements of this Section and the Drawings shall govern. However, nothing in this Section of the Drawings shall be construed to permit work not conforming to all governing codes and regulations.

1.06 REFERENCES

- A. Design, manufacture, test, and install data distribution systems per manufacturer's requirements and in accordance with NFPA 70 (National Electrical Code), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following ANSI/TIA/EIA Standards:
 1. This Technical Specification and Associated Drawings.
 2. ANSI/TIA/EIA 568-B Series, Commercial Building Telecommunications Cabling Standard, and its published addenda.
 3. ANSI/TIA/EIA 568-C.0, Generic Telecommunications Cabling for Customer Premises, and its published addenda.
 4. ANSI/TIA/EIA 568-C.1, Commercial Building Telecommunications Cabling Standard, and its published addenda.
 5. ANSI/TIA/EIA 568-C.3, Optical Fiber Cabling Components Standard, and its published addenda.
 6. ANSI/TIA/EIA 569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, and its published addenda.
 7. ANSI/TIA/EIA 606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, and its published addenda.
 8. ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, and its published addenda.
 9. Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM).
 10. AMP NETCONNECT Design and Installation Contractor Agreement.

11. ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers, and its published addenda.
 12. AMP NETCONNECT Under Carpet Cabling Planning and Installation Manual (409-5566).
- B. The Contractor is responsible to determine and adhere to the most recent edition of these standards when developing their responses.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meetings:
1. Early in the construction timeline, and before any shop drawings are produced, a representative of the low-voltage communications installer, who shall serve as supervisor to the installation crew throughout construction, shall attend a pre-construction meeting where installation details, including labeling, and wire management will be discussed.
 2. Coordinate statements with provisions of Division 01, Section 01 31 00 "Project Management and Coordination".
 3. Coordinate with Division 01, Section 01 12 00 "Multiple Contract Summary" and 01 12 16 "Work Sequence".
 4. Coordinate with Division 01, Section 01 32 00 "Construction Progress Documentation" and 01 32 13 "Scheduling of Work".
- B. The necessity to coordinate this work with the Serving Utility, Owner, and the Contracting Agency is emphasized. The Contractor shall be responsible for any omissions, delays, and additional cost due to lack of coordination or approval from the same.
- C. Coordinate work with other Contractors and trades. The layout and installation of the systems shown on the Drawings and specified herein shall be coordinated such that all special requirements for telecommunications systems shall be provided and incorporated into the project. The systems to be coordinated shall include (but are not limited to) electrical raceway, grounding, fire rated assemblies, lighting, power distribution, control and instrumentation, and labeling of cables, terminations, outlets, jacks, etc. Report all conflicts to the Contracting Agency.

1.08 SUBMITTALS

- A. The Contractor shall furnish the following in a single consolidated submittal with an approval copy to the Owner:
1. Contractor's license number and proof of qualifications as required above.
 2. Contractor's certification certificate from AMP.
 3. The name of the person who will act as the Contractor's official contact with the Contractor/Owner/Engineer.
 4. The name of every certified Category 6 and fiber optic cable installation technician who may be used in the conduct of the project, and evidence of certification of each.

5. To qualify, under the preceding paragraph, courses attended must include hands-on access to cable and terminating tools and materials, and test equipment required to perform the installation functions required in the work of this contract.
 6. Complete manufacturer's product literature for all products to be used in the installation except for Owner furnished materials. In addition, whenever Owner/Engineer pre-approved prior to bid substitutions for recommended products are made, samples (when requested by the Owner/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. Product submittals must be keyed to the Specification or Drawing references.
 7. Shop Drawings:
 - a. Proposed cable routing shall be submitted and approved prior to installation of any cables.
 - b. The Contractor shall submit scaled drawings of all proposed changes in communications room installation detail.
 8. Proposed Contractor Category 6 UTP and fiber optic cable test result forms. Backbone UTP cables shall be tested as provided herein. Contractor shall provide test documentation and forms.
 9. Examples of the cable labeling materials and proposed arrangement. Submittal must include actual samples of each type or proposed connecting fixture, with realistic labels attached.
- B. A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution systems described for this project. At a minimum, this Construction Schedule shall include the following milestones:
1. Start and completion of Communications Room installation.
 2. Start and completion of backbone cable installation.
 3. Phasing of station cable installation.
 4. Testing dates.
 5. Cable label documentation delivery.
 6. Final inspection.
- C. Product Data:
1. The Customer's Cable Infrastructure Project requires an AMP NETCONNECT Systems structured cabling system. The cabling system shall be backed by Tyco Electronics 25-Year System Warranty.
- D. Shop Drawings:
1. Indicate typical layout including dimensions and other data necessary for satisfactory construction that are not shown in the Contract Documents.
 2. Submit detail drawings of outside plant cabling including distances and pathways.
 3. Submit detail drawings of special accessory components not included in Tyco Electronics/AMP NETCONNECT product data.
 4. The Contractor shall provide the central drawing set to the Owner at the conclusion of the project. The marked up drawing set will accurately depict the as-built status of the system including termination locations, cable routing, and all administration labeling for the cabling system. In addition, a narrative will be provided that

describes any areas of difficulty encountered during the installation that could potentially cause problems to the telecommunications system.

- a. Proposed cable routing shall be submitted and approved prior to installation of any cables.
- b. The Contractor shall submit scaled drawings of all proposed changes in communications room installation detail.

E. Manufacturer Instructions:

1. The Customer's technical representative will make periodic inspections of the project in progress. One inspection shall be performed at the conclusion of cable pulling, prior to closing of the false ceiling, to inspect the method of cable routing and support and the firestopping of penetrations. A second inspection will be performed at the completion of cable termination to validate that cables were dressed and terminated in accordance with the latest revision of the ANSI/TIA/EIA 568 Standards for jacket removal and pair untwist, compliance with Manufacturer's minimum bend radius, and that cable ends are dressed neatly and orderly.

1.09 PROJECT OBSERVATION AND FINAL ACCEPTANCE

- A. The Contractor shall request interim observations by the Owner/Engineer throughout the course of the project to avoid costly corrections at the end of the project.
- B. The Contractor shall incorporate in the construction schedule a minimum 2-week period for the final review and project observation process. During this period, the Owner/Engineer will review the project completion submittals and conduct on-site observation.
- C. The Field Drawings will be checked for completion and accuracy to be compared to the Engineer provided Construction Documents and details from the start of the project.
- D. The Owner/Engineer will generate a list of materials and workmanship that are not acceptable (in a project observation report/punchlist). Any part of the system, materials or workmanship, not meeting the requirements of this Section, and not otherwise accepted by the Owner/Engineer, shall be corrected by the Contractor at no additional cost to the Owner prior to final acceptance.
- E. A follow-up observation shall be made after the Contractor has made all corrections necessitated by earlier project observation reports. This review and observation process will be repeated as required until final acceptance is granted.
- F. If completed test results for copper and fiber cables are questionable in regard to failures, an independent spot test on cables with problems may be done by a different independent contractor, with the cost of such spot-checks to be retained from the Contractor's payments.

1.10 CLOSEOUT SUBMITTALS

- A. Project Completion: As a condition for projection acceptance, the Contractor shall submit to the Owner/Engineer the following for review and approval:
 - 1. Complete manufacturer's product literature and samples (if requested) for all approved substitutions to the recommended products made during the course of the Project.
 - 2. An exceptions list of deviations (in materials, construction, and workmanship) from that specified in this Section and shown on the Project Drawings. The Owner will review this list and declare each item as either an approved exception, or as one the Contractor must correct.
 - 3. Field Drawings: Throughout the course of the project, details concerning the exact physical layout or arrangement of the backboards as shown on the Construction Drawings and details shall be marked on a field set (with dimensions in inches) reserved for this purpose. The Field Drawings shall be available throughout the project for inspection, and shall be submitted to the Consultant/Engineer at project completion with changes, "as-builts", in both PDF and AutoCAD format and submitted on CD. The Field Drawings shall be clear and accurate so that the original Construction Drawings can be brought up-to-date by the Contractor.
 - 4. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system and shall perform such inspections to insure that the materials supplied and the work performed conforms to the Contract Requirements. The Contractor shall provide written documentation, which indicates materials acceptance testing was conducted as outlined in Part 3 below. The Contractor shall also provide documentation which indicates that all cable termination testing was completed and that all irregularities were corrected prior to the job completion.
- B. Test and Evaluation Reports:
 - 1. Test documentation shall be provided in a three-ring binder(s) within three weeks after the completion of the project. The binder(s) shall be clearly marked on the outside front cover and spine with the words "Test Results", the project name, and the date of completion (month and year). The binder shall be divided by major heading tabs: Horizontal and Backbone. Each major heading shall be further sectioned by test type. Within the horizontal and backbone sections, scanner test results (Category 6), fiber optic attenuation test results, OTDR traces (if any), and green light test results shall be segregated by tab. Test data within each section shall be presented in the sequence listed in the administration records. The test equipment name, manufacturer, model number, and last calibration date will also be provided at the end of the document. The test document shall detail the test method used and the specific settings of the equipment during the test.
 - 2. When repairs and retests are performed, the problem and corrective action taken shall be noted, and both the failed and passed test data shall be collocated in the binder.
- C. Maintenance Contracts:
 - 1. The Contractor shall furnish an hourly rate with the proposal submittal which shall be valid for a period of one year from the date of acceptance. This rate will be used when cabling support is required to affect moves, adds, and changes (MACs) to the

system. MACs performed by an authorized Contractor shall not void the Manufacturer's warranty.

D. Warranty Documentation:

1. The Contractor shall facilitate a 25-year system performance warranty between the Manufacturer and the Owner. An extended component warranty shall be provided which warrants functionality of all cabling and connectivity components used in the system for 25-years from the date of acceptance. The performance warranty shall warrant the installed horizontal copper and both the horizontal and the backbone optical fiber portions of the cabling system. Copper and fiber optic drops shall be warranted to the link performance as defined in the most recent revisions of ANSI/TIA/EIA 568 standards, or the channel performance in the most recent revisions of ANSI/TIA 568 standards for Category 6 Cabling.

1.11 QUALITY ASSURANCE

A. Manufacturer:

1. Tyco Electronics/AMP NETCONNECT.

B. Installer:

1. The Contractor shall maintain current status with the warranting manufacturer. After installation, the Contractor shall submit all documentation to support the warranty in accordance with the manufacturer's warranty requirements, and to apply for said warranty on behalf of the customer. The warranty shall cover a defective component when a valid warranty claim is submitted within the warranty period.

C. Documentation demonstrating that the Contractor employs a minimum of one Registered Communications Distribution Designer (RCDD) certified by and in current good standing with BICSI. The RCDD shall be a direct full time employee of the Contractor (i.e. an RCDD consultant/sub-contractor to the Contractor is not acceptable). The document shall also declare that the Contractor will continue to employ a minimum of one RCDD throughout the duration of the project.

1. During the course of construction, the Contractor's RCDD shall periodically (once per two-week period) review, on site, the construction in progress for conformance to ANSI/TIA/EIA and BICSI installation standards, and shall provide a written report to the Owner/Engineer on company letterhead which details the work reviewed and states that the work conforms to ANSI/TIA/EIA and BICSI installation standards.
2. After substantial completion and prior to Owner acceptance, the Contractor's RCDD shall certify in writing on company letterhead that the completed installation meets or exceeds ANSI/TIA/EIA and BICSI installation standards. The written certification shall be complete with the RCDD's stamp and certification number, and shall bear the RCDD's signature across the face of the stamp.

D. The Owner reserves the right to exercise its discretion to require the Contractor to remove from the project any such employee of the Contractor deemed by the Owner to be incompetent, careless, or insubordinate.

E. Personnel, whom the Contractor intends to use as supervisors or testers, and at least (50%) half of the installation technicians at large, must have been employed

by the Contractor for at least six (6) months as of the date of bid opening. Proof of AMP and AMP certification for each technician is required showing they have been trained and are familiar with the products they will be installing. Technicians shall have been trained on the Contractor's company policies with respect to personnel safety, telecommunications industry cabling quality and neatness standards, and the use of CSI-standard specifications and drawings.

- F. The selected Low-Voltage Installer must be licensed, bonded, and insured in the State of Washington.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site in manufacturer's original, unopened, protective containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in secure, clean, and dry area indoors in accordance with manufacturer's instructions.
- C. Protect materials and finish from damage and moisture during handling and installation.

1.13 WARRANTY

- A. Manufacturer's Warranty:
 - 1. The Contractor shall facilitate a 25-year system performance warranty between the Manufacturer and the Owner. An extended component warranty shall be provided which warrants functionality of all cabling and connectivity components used in the system for 25-years from the date of acceptance. The performance warranty shall warrant the installed horizontal copper and both the horizontal and backbone optical fiber portions of the cabling system. Copper and fiber optic drops shall be warranted to the link performance as defined in the most recent revisions of ANSI/TIA/EIA 568 standards, or the channel performance in the most recent revisions of ANSI/TIA 568 standards for Category 6.
 - 2. Upon completion of the project, the Customer's technical representative will perform a final inspection of the installed cabling system with the Contractor's project foreman. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the Customer.
 - 3. Upon receipt of the test documentation, the Customer reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. Customer testing will use the same method employed by the Contractor, and minor variations will be allowed to account for differences in test equipment and test variability. If significant discrepancies are found, the Contractor will be notified for resolution.
 - 4. During the three week period between final inspection and delivery of the test and as-built documentation, the Customer will activate the cabling system. The Customer will validate operation of the cabling system during this period.

5. Completion of the installation, in-progress and final inspections, receipt of the test, receipt of the as-built documentation, and successful performance of the system for a two week period will constitute acceptance of the system.
- B. Special Warranty:
 1. The Contractor shall warrant the cabling system against defects in workmanship for a period of one year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All material required for a complete installation shall be furnished by the Contractor.
- B. All materials must be new, free from defects and not less than the quality specified herein. They shall be designed to insure satisfactory operation and operation life in the environmental conditions which will prevail where they are being installed.
- C. Each type of materials bid and furnished shall be of the same make and shall be of the standard products or manufacturers regularly engaged in the production of such materials and shall be the manufacturer's latest standard design.
- D. Materials shall be as listed or shall be equivalent products of other manufacturers meeting the intent and quality level of the specifications. Any approved equivalent products will be published by addendum prior to bid.
- E. Security: Contractor shall furnish and maintain suitable lockable storage locations for on-site secure storage of materials. Any lost, stolen, damaged, or cut materials shall be replaced by the Contractor.
- F. No custom items shall be used except as specified on the Construction Drawings, or as reviewed and approved by both the Owner and Engineer as required to meet unusual physical requirements of the installation site.

2.02 WIRE PLANT MATERIALS

- A. Materials shall be as listed and labeled.
- B. All products shall be new, and brought to the job site in original manufacturer's packaging. Electrical components (including innerducts) shall bear the Underwriter's Laboratories label and/or the CSA equivalent. All communications cabling shall bear flammability testing ratings as follows:

CM	Communications Cable
CMR	Riser-rated Communications Cable
CMP	Plenum Rated Communications Cable

All voice and data station cables specified herein shall be CMP plenum as required by codes.

- C. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the real identification label, that it is of proper gauge, containing correct number of pairs, etc. Note any buckling of the jacket which would indicate possible problems. Damaged cable or any other components failing to meet the specifications shall not be used in the installation.

2.03 OWNER FURNISHED

- A. None.

2.04 MANUFACTURED COMPONENTS

- A. Manufacturer List:

1. Tyco Electronics/AMP NETCONNECT.
2. Or Approved Equal.

- B. Product Options:

1. Category 6 Patch Panels for Voice and Data Circuits: Patch Panels.
 - a. Horizontal termination for voice and data circuits shall consist of Category 6 patch panels, which shall be 1U high and provide 24 modular jack ports wired to T568B. Patch panels shall be configured with individually replaceable jacks. Modular jacks shall be compatible with AMP NETCONNECT SL Series Modular Jack Termination Tool Part Number 1725150-1.
 - b. Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.
 - c. The front of each 6-port module shall be capable of accepting 9mm to 12mm labels. Each port shall be capable of accepting an icon to indicate its function. Patch panels shall terminate the building cabling on 110-style insulation displacement connectors. Patch panels shall meet the ANSI/TIA-568-C.2 requirements for Category 6 performance.
 - d. Each modular jack shall be bagged separately from the patch panel.
 - e. Patch panels shall be C product part number(s) 1499601-1, refer to Table 4 below:

Description	Port Count	Rack Mount Units	Part Numbers
Category 6 SL Series Patch Panel	24	1U	Unloaded, jacks bagged 760237040

Patch Panel Part Numbers
TABLE [4]

- f. Category 6 patch panels shall meet the technical details and performance characteristics listed in Tables [5] and [6].

Technical Information

Materials	
Connector Housing Interface (6-pack Module) -	Polyester molding compound, black
Panel -	Steel, black powder coat
Modular Jacks -	See cut sheet for 1375055-X
Screws -	12-24 x 0.5 in [12.7 mm], black
Screws -	10-32 x 0.5 in [12.7 mm], carbon steel, cross recessed
Approvals	
UL Listed – File Number: E81956	
TABLE [5] CAT 6 PATCH PANEL TECHNICAL DETAILS	

Worst-Case Performance Characteristics (meet or exceed ANSI/TIA-568-C.2 and ISO/IEC Category 6/Class E requirements)

Frequency MHz	Insertion Loss dB		Return Loss dB		NEXT dB		FEXT dB	
	Cat 6 Standard	Max	Cat 6 Standard	Min	Cat 6 Standard	Min	Cat 6 Standard	Min
1	0.10	0.02	30	52.4	75.0	84.8	75.0	83.7
4	0.10	0.02	30	53.7	75.0	80.3	71.1	74.8
8	0.10	0.02	30	55.3	75.0	77.4	65.0	69.4
10	0.10	0.03	30	56.1	74.0	76.4	63.1	67.5
16	0.10	0.03	30	57.6	69.9	72.0	59.0	62.9
20	0.10	0.04	30	59.3	68.0	71.9	57.1	61.7
25	0.10	0.04	30	59.4	66.0	69.1	55.1	59.8
31.25	0.11	0.05	30	56.8	64.1	67.7	53.2	58.2
62.5	0.16	0.06	28	42.3	58.1	61.5	47.2	52.6
100	0.20	0.06	24	33.2	54.0	57.7	43.1	48.7
200	0.28	0.06	18	21.2	48.0	52.5	37.1	42.2
250	0.32	0.10	16	17.4	46.0	47.9	35.1	40.1

TABLE [6]
CAT 6 PATCH PANEL PERFORMANCE CHARACTERISTICS

2. Telecommunications Room Fiber Terminations:

- a. The enclosures used in the Communications Rooms for the optical fiber risers shall be of sufficient size and capacity to terminate all of the combined fiber count of the vertical riser fiber optic cables including growth room as per best practice. The Contractor shall provide complete fiber optic patch panels and all required materials, i.e., coupler panels, blank panels and

- connectors, as shown on plans for single or multimode fiber terminations.
- b. All front or rack fiber connectors shall be LC connectors.
 - c. All fiber within the building (between racks or between TRs) shall be 12-strand MPO style fiber cables with appropriate 12-strand MPO cassettes used for termination.
 - d. Multimode fiber run between racks or between TRs shall be OM3 rated.
 - e. Appropriate cleaners shall be used prior to connecting any MPO connector.
 - f. Fiber optic cables shall be terminated with LC connectors in each Telecommunications Room (TR). Terminations shall be housed in 1U, 2U, or 3U rack-mount enclosures providing protection for the terminated fibers. LC connectors shall accept 900µm buffered OM3 50/125µm or singlemode fiber.
 - g. Duplex OM3 50/125µm and singlemode LC connectors shall be no-epoxy/no-polish and shall terminate with 900µm tight-buffered fiber. LC connectors shall meet the most recent version of TIA/EIA-568-C.3 standard, and its published addenda.
 - h. No-epoxy/no-polish LC connectors shall be compatible with AMP NETCONNECT Termination Tool Kit part number(s) 1754845-1.
 - i. LC connectors in the TR shall be AMP NETCONNECT product part numbers, see Table 7 below:

Simplex/Duplex LC Connectors	No-Epoxy/No-Polish
Duplex, OM2 50/125µm	6754485-2
Angled Polish, SingleMode	2064181-1
Simplex, SingleMode	6754482-1
Duplex, SingleMode	6754484-1
MPO 12-Strand Fiber OM3 MM	1907404-X
MPO 12-Strand Fiber SM	6435070-X

TABLE [7]
LC CONNECTOR PART NUMBERS

- j. Each LC connector shall be held by an LC duplex coupler snap-in adapter plate. Adapter plates shall be installed into rack-mount fiber optic enclosures. LC duplex snap-in adapter plates shall be AMP NETCONNECT product part numbers, see Table 8 below:

Adapter Description	Fiber Count	Fiber Type	Adapter Color	Part Number
LC Adapter	12		Black	760245730

TABLE [8]
LC ADAPTER PLATES

- k. Fiber optic enclosures shall be capable of containing 72 LC simplex connectors or 72 LC duplex connectors.

- I. Fiber optic enclosures shall be AMP NETCONNECT product part numbers, see Table 9 below.

Description	Fiber Count	Port Count	Rack Units	Part Numbers
Rack Mount Patch Enclosure, Standard Cables	72	12	1U	760248335

TABLE [9]
FIBER ENCLOSURE PART NUMBERS

- C. Performance:
1. Copper and Fiber Optic drops shall be warranted to the link performance as defined in the most recent revisions of ANSI/TIA/EIA-568 Standards, or the channel performance in the most recent revisions of ANSI/TIA-568 Standards for Category 6.
- D. Finishes:
1. Color and finish as selected by Architect.

PART 3 – EXECUTION

3.01 INSTALLERS

- A. The Contractor shall maintain current status with the warranting manufacturer, including all training requirements, for the duration of the Cable Infrastructure Project. The Contractor shall staff each installation crew with the appropriate number of trained personnel, in accordance with their manufacturer/warranty contract agreement to support the 25-Year System Warranty requirements.

3.02 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 01 71 00.

3.03 INSTALLATION

- A. Install all systems in accordance with manufacturer's printed instructions, as well as all State of Washington codes and standards.
- B. Install wall plate units plumb, level, square, and free from warp or twist while maintaining dimensional tolerance and alignment with surrounding construction adjacent surfaces.
- C. All MPO connectors shall be appropriately cleaned immediately prior to being connected.
- D. Special Techniques:

1. Termination of RJ45 modular jacks shall be completed using a hand tool which employs a fully repeatable, self-centering, non-impact mechanical termination process. This process shall simultaneously cut and terminate all 8 conductors to the modular jack.

3.04 RE-INSTALLATION

- A. Any component that must be removed to install other items shall be replaced as it was originally and retested to all standards as if it was a newly installed component.

3.05 FIELD QUALITY CONTROL

- A. Copper and Fiber Optic Systems shall be installed as defined in the most recent revision of the ANSI/TIA/EIA-568 specifications.
- B. Field Tests:
 1. Copper and Fiber Optic Systems shall be field tested as defined in the most recent revision of ANSI/TIA/EIA-568 specifications.
- C. Non-Conforming Work:
 1. Any work not conforming to the terms of this contract, including but not limited to, improper cable handling, bend radius, termination techniques, overfill of conduits or trays, etc., will at the cost of the Contractor be removed and replaced with brand new products.

3.06 CLOSEOUT ACTIVITIES

- A. Owner manuals for any products that are not explicitly mentioned in these specifications that are installed by the Contractor will be provided to the Owner.
- B. Any product that is installed as an alternative to a product mentioned in these specifications, and that has any different operation than the original product; the Contractor will provide sufficient training for up to 3 members of the Owner's personnel in the correct usage of the alternate item. Training shall include hands on use of the alternate item(s).

END OF SECTION

SECTION 27 05 01

BASIC MATERIALS & METHODS FOR COMMUNICATION SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Provide a complete raceway system in accordance with ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, BiCSi, NEC, and UL.
- B. All installations shall comply with ADA requirements.
- C. Provide raceway systems for the installation of the communications wiring. Installations shall include, but not be limited to, raceways, outlet boxes, plaster rings, outlet box cover plates and terminal boards.
- D. Provide a raceway from each communications outlet to the nearest cable tray or MDF/IDF room.
- E. Provide raceway sleeves through all fire and smoke separation walls.
- F. Provide UL listed fire stop material to maintain separation requirements.
- G. Provide raceways to outlets located in fixed casework.
- H. Provide plastic bushings on both ends of all communications sleeves and conduits.
- I. Provide pull strings in all raceways and sleeves.

1.03 RELATED SECTIONS

- A. Section 26 05 01 "Basic Materials and Methods for Electrical Systems".
- B. Section 26 05 33 "Raceways and Boxes".
- C. Section 27 05 26 "Grounding and Bonding for Communications Systems".

1.04 REFERENCES

- A. Section 26 05 01 "Basic Materials and Methods for Electrical Systems".

1.05 SUBMITTALS

- A. Refer to Section 26 05 01 "Basic Materials and Methods for Electrical Systems".

1.06 QUALITY ASSURANCE

- A. Refer to Section 26 05 01 "Basic Materials and Methods for Electrical Systems".

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 26 05 01 "Basic Materials and Methods for Electrical Systems".

1.08 WARRANTY

- A. Refer to Section 26 05 01 "Basic Materials and Methods for Electrical Systems".

1.09 COMMISSIONING OF COMMUNICATIONS SYSTEMS

- A. Coordinate Contractor requirements with Commissioning Agent and Owner.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Coordinate requirements with Owner.

PART 2 – PRODUCTS

2.01 OUTLETS

- A. Shall consist of a 5" square, 2.875" deep box with 64 cubic inches volume, integral cable management, and knockouts for 1" and 1.25" conduits.
 - 1. Box shall be Randl 5 SQUARE series #T-55017, or other reviewed and approved Manufacturers, telecommunications box.
- B. Provide 5/8" double-gang device plaster ring for all data, or combination voice, data, and media box locations.
 - 1. Data or combination plaster ring shall be Randl 5 SQUARE series #L-52G058, or other reviewed and approved Manufacturers.
- C. Provide 5/8" single-gang device plaster ring for all voice wall-mounted phone box locations.
 - 1. Voice only plaster ring shall be Randl 5 SQUARE series #L-51G058, or other reviewed and approved Manufacturers.

2.02 PULL FITTINGS

- A. Provide pull fittings where pull points are required for a single conduit.
- B. Where the following pull fittings will not work, provide a pull box per section 2.3 below.
- C. Provide pull fittings 1 trade size larger than conduit.
- D. Provide reducing fittings as required:
 - 1. In-line straight pull fitting shall be Aluminum with integral rollers. Shall be supplied complete with body, gasket, cover, and captive stainless steel screws.
 - a. Straight pull fitting shall be OZ Gedney mogul conduit body type C.
 - b. Provide C8X-150MA and reducing fittings for use on 1.25" conduit.
 - 2. 90-degree pull fitting shall be aluminum with integral rollers. Shall be supplied complete with body, gasket, cover, and captive stainless steel screws.
 - a. Straight pull fitting shall be OZ Gedney mogul conduit body type LB.
 - b. Provide LB6X-150MA and reducing fittings for use on 1.25" conduit.

2.03 PULL BOXES

- A. A pull box must not be used in lieu of a bend.
- B. Pull boxes used in a straight run of conduit shall have a minimum length of 8-times the internal diameter of the largest conduit.
- C. Pull boxes used for angled or "U" pulls shall have:
 - 1. A distance between each conduit(s) and between the conduit and the opposite wall of the box of not less than 6-times the internal diameter of the largest conduit.
 - 2. A distance between the edges of conduits enclosing like conductors of at least 10-times the size of the conduits.
- D. Pull boxes for conduits entering opposite to a removable cover shall have a distance from the wall to the cover of not less than the size of the conduit plus 6-times the diameter of the largest conduit.
- E. Provide 3/4" fire treated plywood backboard, boxes, and internal cable management for cables. Maintain bend radii of cables of no less than ten (10) times the cable diameter.
- F. Manufacturer: Appleton, or other reviewed and approved Manufacturers.

2.04 PULL CORD

- A. Shall be nylon or polyester having not less than 210-pounds of tensile strength.
- B. Approved Manufacturer: Greenlee, Part #430, or other reviewed and approved Manufacturers.

2.05 IDF ROOM BACK BOARDS

- A. Shall be 3/4" fire treated plywood backboard. APA exterior grade douglas fir A-C. Shall be coated with white color fire retardant paint with flame spread rating of not more than 25 when tested according to ASTM E84. Manufacturer fire retardant stamp shall not be painted over and shall remain visible after installation is complete. Extend plywood backboard at extension of room to cover new wall surface.

2.06 COVER PLATES

- A. Provide per Section 27 15 43 "Communications Faceplates and Connectors".
- B. Contractor shall provide blank cover plates for all unused telecommunications boxes.

2.07 CONDUCTORS

- A. Provide per Section 27 15 13 "Communications Copper Horizontal Cabling".

PART 3 – EXECUTION

3.01 RACEWAYS

- A. Conform to the following:
 - 1. Conduits shall not serve more than one outlet box.
 - 2. Provide a minimum of one (1) accessible straight pull fitting in each run of conduit. See Section 2.2.D above.
 - 3. No section of conduit shall exceed 100-feet in length or have more than 180-degrees of bend or the equivalent between pull points.
 - 4. No section of conduit will have greater than a 180-degree bend without a pull box.
 - 5. Provide a pull fitting or junction boxes in an accessible location that can be reached when standing two rungs from the top of an 8-foot step ladder where necessary.
 - 6. Inside radii of bends in raceways shall not be less than ten (10) times the nominal diameter.
 - 7. Terminate raceway at the bottom or the top edge of the backboard or in terminal cabinet with two (2) locknuts and a plastic bushing.
 - 8. Raceways and raceway sleeves shall be sized as follows unless shown to be larger:

- a. Conduit and Raceway Fill (single or multiple cables): Communication raceways shall not be filled beyond 40% capacity after bends are calculated at 15% loss of area, per 90-degree (or equivalent) bend.
- b. Refer to Table 1 below for the maximum cable count for various quantities of 4-pair cables:

TRADE SIZE	TOTAL AREA	BEND LOSSES	40% FILL	MAXIMUM QTY OF CABLES
1.25 inch	1.50	0.45	0.42	6
1.5 inch	2.04	0.612	0.57	8
2 inch	3.36	1.008	0.94	14
2.5 inch	4.79	1.437	1.34	20
3 inch	7.38	2.214	2.06	32
3.5 inch	9.90	2.97	2.77	43
4 inch	12.72	3.816	3.56	55

TABLE 1
RACEWAY CAPACITY IN NUMBER OF 4-PAIR CABLES

3.02 FIRESTOPPING

- A. Provide firestopping in empty raceways that penetrate rated floors and rated walls. Refer to Architectural for fire ratings of floors and walls.

3.03 PULL CORDS

- A. Shall be included in all raceways. Provide pull cords in conduits after cables have been installed. Leave 18" of slack (tied off) at each end of the raceway.

3.04 GROUNDING/BONDING

- A. Provide grounding in accordance with Section 27 00 20 and the following:
 - 1. Provide a low impedance (5 ohms or less) grounding system to support the communications system.
 - 2. Provide a continuous #6 bare stranded copper grounding conductor from the IDF ground bus to the rack.
 - 3. Provide a continuous #6 bare stranded copper grounding conductor from the IDF ground bus to the cable tray.
 - 4. Provide a continuous #6 bare stranded copper grounding conductor from the cable tray to any existing cable tray, where applicable.
 - 5. Provide a continuous #6 bare stranded copper grounding conductor from the IDF ground bus to the cable runway.
 - 6. Provide a continuous #6 bare stranded copper grounding conductor from the cable runway to the existing runway, where applicable.
 - 7. Provide a continuous #10 bare stranded copper grounding conductor from the cable tray to each low-voltage systems conduit.
- B. Completely remove any paint of factory finish from surfaces where bonding shall occur.

- C. Bonding lugs shall be two hole hydraulic compression type lugs only. No set screws or mechanical compression types permitted.

3.05 RACEWAY RISER SLEEVES

- A. Riser raceways shall be 4" trade size and shall be installed through floors with tops 6" above each floor to give continuous cable riser capability.
- B. Provide plastic cap bushings on all sleeves.
- C. Pack sleeves with a UL listed fire stop material to maintain fire separations.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING OF COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.

1.02 SUMMARY

- A. Provide all labor, materials, and equipment for the complete installation of grounding and bonding for communication and low-voltage systems and as shown in the Drawings.
- B. This Section includes the minimum requirements for the equipment and cable installations in communications equipment rooms (MDFs and IDF).
- C. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential for acting as a current-carrying conductor. The TBB shall be installed independently of the building electrical ground and of the building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607-A Telecommunications Bonding and Grounding Standard.
- D. The TBB shall adhere to the recommendations of the ANSI/TIA/EIA-607-A Standard, and shall be installed in accordance with the best industry practices. Installation and termination of the main bonding conductor to the building service entrance ground, at a minimum, shall be performed by a licensed Electrical Contractor.
- E. The MDF and IDF Rooms each shall be equipped with a telecommunications main grounding bus bar (TMGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- F. Included in this Section are the minimum requirements and installation methods for the following:

1. Busbars.
2. Bonding accessories.
3. Grounding and Bonding of Telecommunications Systems.

G. Product numbers have not been shown due to variability in manufacturer's nomenclature. Provide manufacturer's standard products that meet the Specification requirements of this Section.

1.03 RELATED SECTIONS

- A. Section 26 05 00 "Common Work for Electrical Systems".
- B. Section 26 05 26 "Grounding and Bonding".
- C. Section 26 05 33 "Raceways and Boxes".
- D. Section 27 05 01 "Basic Materials and Methods for Communications Systems".

1.04 REFERENCES

- A. Materials and work specified herein shall comply with the applicable requirements of:
 1. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard (2000-2004).
 2. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces (2004).
 3. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings (2002).
 4. ANSI-J-STD-607-A Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications (2002).
 5. NFPA 70 – National Electrical Code (2017).
 6. BICSI – Telecommunications Distribution Methods Manual, 11th Edition (2006).

1.05 SUBMITTALS

- A. Provide product data for the following:
 1. Manufacturers cut sheets, specifications, and installation instructions for all products.

1.06 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner.
- B. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner or Owner's Representative.
- C. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified shall be based upon the acceptable manufacturers listed.

- D. The TBB shall be designed and/or approved by a qualified Professional Engineer (PE), licensed in the State that work is to be performed. The TBB shall adhere to the recommendations of the ANSI/TIA/EIA-607-A standard, and shall be installed in accordance with the best industry practices. Installation and termination of the main bonding conductor to the building service entrance ground, at a minimum, shall be performed by a licensed Electrical Contractor.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Tyco Electronics/AMP NETCONNECT.
- B. Chatsworth.
- C. Erico.
- D. Or other reviewed and approved manufacturers.

2.02 WALL-MOUNTED BUSBARS

- A. Telecommunications Grounding Busbar (TGB):
 - 1. TGB shall be constructed of 1/4" (6.4 mm) thick solid copper bar.
 - 2. The Busbar shall be 4" (100 mm) high and 12" (300 mm) long and shall have 18 attachment points (two rows of 9 each) for two-hole grounding lugs.
 - 3. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI-J-STD-607-A and shall accept 15 lugs with 5/8" (15.8 mm) hole centers and 3 lugs with 1" (25.4 mm) hole centers.
 - 4. The busbar shall include wall-mount stand-off brackets, assembly screws, and insulators creating a 4" (100 mm) standoff from the wall.
 - 5. The busbar shall be UL listed as grounding and bonding equipment.

2.03 BONDING ACCESSORIES

- A. Two Mounting Hole Ground Terminal Block:
 - 1. Ground terminal blocks shall be made of electroplated tin aluminum extrusion.
 - 2. Ground terminal blocks shall accept conductors ranging from #14 AWG through 2/0 AWG.
 - 3. The conductors shall be held in place by two stainless steel set screws.
 - 4. Ground terminal blocks shall have two 1/4" (6.4 mm) holes spaced on 5/8" (15.8 mm) centers to allow secure two-bolt attachment to the rack or cabinet.
 - 5. Ground terminal blocks shall be UL listed as a wire connector.
- B. Compression Lugs:

1. Compression lugs shall be manufactured from electroplated tinned copper.
 2. Compression lugs shall have two holes spaced on 5/8" (15.8 mm) or 1" (25.4 mm) centers, as stated below, to allow secure two bolt connections to busbars.
 3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0 AWG, as stated below.
 4. Compression lugs shall be UL listed as wire connectors.
 5. Compression lugs:
 - a. Compression Lug, #6 AWG, 5/8" hole spacing, quantity as required.
 - b. Compression Lug, #6 AWG, 1" hole spacing, quantity as required.
 - c. Compression Lug, 2/0 AWG, 1" hole spacing, quantity as required.
- C. Antioxidant Joint Compound:
1. Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.
- D. Equipment Ground Jumper Kit:
1. Kit includes one 24"L insulated ground jumper with a straight two hole compression lug on one end and an L-shaped two hole compression lug on the other end, two plated installation screws, an abrasive pad and a 0.5 ounce tube of antioxidant joint compound. Provide quantity as required.
 2. Ground conductor is an insulated green/yellow strip #6 AWG wire.
 3. Lugs are made from electroplated tinned copper and have two mounting holes spaced 0.5" to 0.625" apart that accept 1/4" screws.
 4. Jumper will be made with UL listed components.

2.04 RACEWAY SLEEVES (FIRE-STOP DEVICES)

- A. Products shall be ELV and RoHS compliant.
- B. The TBB shall adhere to recommendations of the ANSI/TIA/EIA-607-A Standard and shall be installed in accordance with best industry practices.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install all systems in accordance with manufacturer's printed instructions, as well as all Washington State codes and standards.
- B. The MDF and IDF rooms each shall be equipped with a telecommunications main grounding bus bar (TMGB). The TMGB shall be connected to the building entrance electrical grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical grounding

system. Therefore, the ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.

- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MDF and IDF Rooms shall be grounded to the respective TGB or TMGB using a minimum of #6 AWG stranded copper bonding conductor and compression connectors. Where metallic panels attached to the rack do not have sufficient metal to metal contact to provide an adequate path to ground, they shall be bonded to the rack using a minimum #14 AWG copper conductor. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack-mount equipment. The conductor shall be continuous; attaching all isolated components in a daisy chain fashion from top to bottom and bonded to the rack using an appropriate compression connector.
- D. Each rack shall have a vertical rack ground bar installed for the Owner to ground equipment to.
- E. All wires used for telecommunications grounding purposes shall be identified with green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the system documentation section of this Specification.
- F. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed Electrical Contractor.

3.02 WALL MOUNT BUSBARS

- A. Attach busbars to the wall with appropriate hardware according to manufacturer's installation instructions.
- B. Conductor connections to the TGB shall be made with two-hole bolt-on compression lugs sized to fit the Busbar and the conductors.
- C. Each lug shall be attached with stainless steel hardware after preparing the bond according to the manufacturer's recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
- D. The wall-mount busbar shall be bonded to the building's main electrical service grounding grid as part of the overall Telecommunications Bonding and Grounding System.
- E. The TGB shall not be located in a "high traffic area". Field coordinate actual installation prior to rough-in as required to maintain safety.

3.03 GROUND TERMINAL BLOCK

- A. The MDF and IDF cabinet/racks and raceway system shall be bonded to the TGB.

- B. Minimum bonding connections to the cabinet or cable tray shall be made with a rack-mount two-hole ground terminal block sized to fit the conductor and rack, and installed according to manufacturer recommendations.
- C. Remove paint/coatings, etc., between cabinet or cable tray and terminal block, clean surface and use antioxidant between the grounded part and the terminal block to help prevent corrosion at the bond.

3.04 BONDING

- A. All bonding connections shall be cleaned of all foreign materials for a solid metal-to-metal connection.
- B. All connections shall be made with bolts, locking washers, and nuts. No machine threaded or self-tapping hardware is permitted. Use only stainless steel hardware.
- C. The MDF and IDF cabinets/racks, cable trays, cable runways, and raceway system shall be bonded to the TGB.
- D. All bonding connections shall be made with a two-hole ground terminal block sized to fit the conductor and equipment installed according to manufacturer's recommendations.
- E. Remove paint/coatings, etc., from all mating surfaces prior to performing any bonding work.
- F. Clean surface and use antioxidant between the grounded part and the terminal block.

3.05 EQUIPMENT GROUND JUMPER KIT

- A. Bond equipment to the ground bar (TGB) using ground jumpers according to the manufacturer's recommendations.
- B. Clean the surface and use antioxidant between the compression lugs on the jumper, the rack, and the ground bar (TGB), to help prevent corrosion at the bond.

3.06 LABELING

- A. Tag and label all ground cables that are attached to the Telecommunications Ground Bus as specified in CSI 27 05 26, ANSI/TIA/EIA 606, and TIA J-STD 607-A.
- B. Tabs and labeling shall conform to TIA J-STD 607-A.
- C. Tag shall be semi-rigid, UV resistant, polyethylene material, yellow color, and shall be approximately 2.75" long x 1.38" wide with slot for affixing to cable with tie-wrap or approved method.

- D. Each telecommunications grounding and bonding conductor shall be labeled. Labels shall be located on conductors/cables as close as practical to their point of termination in a readable position. Labels shall be nonmetallic and include the information as noted below.
 - 1. Information to be on the tag for each ground cable shall be as noted below:

“WARNING: IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED,
PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER”

3.07 TESTING

- A. The grounding system shall be less than 5 ohms to earth (ground).
- B. Test the grounding system to comply with NETA ATS procedures for grounding systems.
- C. Record all grounding impedances in the O&M Manual.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.01 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, Division 01, Division 26, Division 27, and Division 28.
- B. Review the Specifications and Drawings for coordination with additional requirements and information that applies to work under this Specification.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions, and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Telecommunications backboard.
 - 2. Cable tray.
 - 3. Cable runway.
 - 4. Conduits.
 - 5. Boxes.
 - 6. quality assurance
- B. NFPA 70 – National Electrical Code.
- C. ANSI/TIA 568-C.0 – Generic Telecommunications Cabling for Customer Premise.
- D. ANSI/TIA/EIA 568.C.1 – Commercial Buildings Telecommunications Cabling Standard.
- E. ANSI/TIA/EIA 569 – Commercial Building Standard for Telecommunications Pathways and Spaces.
- F. ANSI/TIA/EIA 606-A – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings; TR-42.6 – Labeling.
- G. ANSI/TIA/EIA 607A – Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.03 EQUIPMENT FINISH

- A. Electrical equipment, control panels, and cabinets, shall be furnished factory painted in the manufacturer's standard colors unless otherwise specified.
- B. Unfinished materials and equipment except conduit, shall be cleaned, primed and painted by the Electrical Contractor as directed by the Owner's Representative in accordance with the Painting Section of the Specifications.
- C. The colors of exposed electrical materials and apparatus shall be as selected by the Owner's Representative.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

1.05 QUALITY ASSURANCE

- A. Source: For each type of material required for the Work of this Section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Make all necessary provisions for storing materials and equipment at the site to insure the quality and condition of the material to be installed. Utilize only new materials which are free of defects and which arrive at the jobsite unopened in the original container.

1.07 COORDINATION

- A. Coordinate location of raceways, supports, cable trays and electrical equipment with other trades.
- B. Determine the exact electrical requirements of all equipment from the equipment suppliers prior to rough in wiring. Refer any discrepancy between the Drawings and equipment requirements to the Architect for resolution prior to installation.
- C. Construction Observation: Advise the Architect at least two (2) full working days prior to the covering of concealed electrical work.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish all items of the materials, design, sizes, and ratings specified herein.
- B. All devices, equipment, enclosures, and material shall be UL listed, Engineer approved, and suitable for its environment where used.

2.02 RACEWAYS AND FITTINGS

- A. All raceways shall be 1/2" minimum and 3/4" minimum for homeruns.
- B. 3/4" raceways shall have no more than six (6) #12 AWG conductors.
- C. Minimize the use of flexible metallic conduit. Flexible conduit shall only be used for light fixture connections, interior equipment connections, expansion and seismic joints, and sound control. Flexible metallic conduit shall not be used in concealed locations.
- D. Electrical Metallic Tubing (EMT): Hot dipped galvanized or sherardized steel. Utilize compression type with insulated throat in interior locations and steel rain tight type in exterior locations. Cast metal shall not be used.
- E. Rigid Galvanized Steel (RGS): Rigid metal conduit shall be galvanized steel type. Conduit fittings and accessories shall be listed for use with RGS.
- F. Polyvinyl-Chloride (PVC): Rigid PVC conduit shall be used in ductbanks and encased in concrete where noted on Drawings.
- G. Flexible Steel Conduit: Interlocking single strip, hot-dipped galvanized or sherardized, liquid-tight when used in wet or damp locations. Fittings shall be screw wedge type or liquid-tight type depending on conduit type used. Provide grounding fittings for ground wire installation outside conduit.
- H. Concealed raceways shall be secured with heavy-duty, single-hole, steel straps. Nail-in style straps shall not be used.
- I. Exposed raceways shall be secured with heavy-duty, two-hole, steel straps.
- J. Exposed raceway running on roofs, surface mounted on building exterior within 10-feet of ground, walkways or stairs, exposed to weather or under covered walkways shall be galvanized rigid steel on rubber support pads with strut straps (not wood).
- K. Raceways shall be supported independently from the ceiling suspension system, cable trays, ducts, and piping.
- L. Pendant mounted groups of raceways shall be supported by 1-5/8" square preformed channel (Unistrut).

- M. Cap or plug the ends of below grade conduits to prevent concrete and other materials from obstructing conduits.
- N. Wherever buried, non-metallic, conduit passes through an expansion or contraction joint, or where required to compensate for thermal expansion and contraction, provide a conduit expansion joint. Install the conduit to cross the joint at right angles.
- O. Pull Wires: Provide a pull wire in all empty raceways:
 - 1. Use nylon pull-wires of tensile strength not less than 240-pounds in each conduit and duct, leave pull-wires in ducts and conduit after cleaning.
 - 2. No splices in pull-wire will be allowed.
 - 3. Leave ample slack length at each end of pull-wire.

2.03 PATHWAYS FOR LOW-VOLTAGE SYSTEMS

- A. Provide a complete pathway system for all low-voltage wiring. Pathways shall consist of "open" cabling supports (D-rings, J-Hooks, etc.), cable tray, or a combination of both. The extent of the cable tray shall be coordinated with the Owner's Representative.
- B. Pathways shall not include inaccessible spaces, unless a continuous conduit is provided through such spaces.
- C. Provide a pull wire in all empty raceways.
- D. Open Cable Supports:
 - 1. Where cables are to be installed as "Open Cabling", cable supports (D-rings, J-hooks, adjustable straps and saddles as appropriate) shall be installed to allow cabling to be grouped and run along a common path. Cables shall be run parallel or at right angles to the building structure, and shall not be looped diagonally across the ceiling space. Cables shall be loosely bundled with cable ties at a minimum every 36" O.C.
 - 2. J-Hooks: Shall comply with TIA requirements for structured cabling system, and have a galvanized finish; Caddy #CAT21 with CATHBA angled hanger bracket or equal. Follow manufacturer's recommendations for quantity of cables supported.
 - 3. Cable Tray:
 - a. Provide 18" wide x 4" deep aluminum ladder style cable tray with 9" rung spacing in all major corridors or as shown in Drawings.
 - b. Provide longitudinal and lateral seismic bracing.
 - c. All penetrations through rated walls shall be firestopped with removable, re-enterable fire stopping system. Fire stopping shall be the responsibility of the Electrical Contractor, not the individual low-voltage subcontractor(s). All conduits/penetrations should be sealed prior to ceiling cover inspection.
 - 4. Ground all cable trays as required per NEC.
 - 5. Do not run cable tray through rated walls or floors. Provide multiple 4-inch raceway sleeves through rated walls and floors to simplify fire stopping.

2.04 RACEWAY SLEEVES (FIRE-STOP DEVICES)

- A. Provide raceway sleeves as required or as indicated on Drawings for low-voltage cabling through walls and floors. Sleeves shall be Hilti model CP-653 or approved equal. Provide diameter size as required. Sleeves shall have the following features at a minimum:
 - 1. Shall be re-penetrable, high capacity cable management devices for low-voltage cable routing.
 - 2. Shall have the ability to re-penetrate from one side of the wall.
 - 3. Shall have 100% visual fill.
 - 4. Can be installed in wall and floor applications.
 - 5. Fire-rated for up to 3-hours in concrete and fire-rated up to 4-hours for gypsum walls.

2.05 WIRE AND CABLE

- A. Branch circuit wiring shall be #12 AWG copper minimum unless indicated otherwise. Conductors #10 AWG and smaller shall be solid copper with Code grade insulation and a minimum temperature rating of 75 deg C.
- B. Branch circuit ground wire, isolated ground wire, equipment grounding conductor and grounding electrode conductors shall be insulated the same as the circuit or feeder conductors.
- C. Conductors #8 AWG and larger shall be stranded copper, with Code grade insulation and a minimum insulation temperature rating of 75 deg C, and connected to equipment by means of compression type terminal lugs. Compression lugs shall be hydraulic compression only. Mechanical compression methods are not acceptable. Provide two-hole lugs of AL/Cu type only. Single hold lugs are not acceptable.
- D. Marking: Wire must be marked at 2' intervals with gauge, insulation type, and manufacturer. Label feeders at each end of phase designation.
- E. Low voltage wiring and cables specified herein by Divisions 26, 27, or 28 shall be installed either in complete raceway system or shall be plenum rated.

2.06 JUNCTION AND PULLBOXES

- A. Manufacturers: Bower, Raco or Steel City. Boxes exposed to weather shall be Crouse Hinds or approved equal cast aluminum type.
- B. Electrical boxes shall conform to UL-50, "Standard for Electrical Enclosures" and UL-514, "Standard for Electrical Outlet Boxes and Fittings".
- C. Provide electrical boxes of the material, finish, type, and size indicated and required for the location, kind of service, number of wires, and function.

- D. Electrical boxes that are shown on the Drawings with no indication of size shall be provided in accordance with the NEC.
- E. Junction boxes, pull boxes, and outlet boxes shall be pressed steel with knockouts and matching cover as required with size, depth, and shape best suited to the location and intended service. Cover on finish area shall be provided with specification grade quantity type to match finish surface. Include plaster or tile rings as required.
- F. Provide neoprene gaskets 1/8" thick with all boxes subjected to weather.
- G. Grounding: Provide each box with a grounding terminal.
 - 1. Grounding Terminal: Either a green-colored washer-in-head machine screw not smaller than 10-32 in a drilled and tapped hole in the back of the box or a grounding bushing with green-colored machine screw terminal attached to one of the conduits.
 - 2. Install grounding jumpers as specified in 26 05 26 "Grounding and Bonding".

2.07 SUPPORTING DEVICES

- A. Provide dedicated blocking and support method to ensure secure installation of all device boxes such that the installation is capable of withstanding a minimum 50-pound pulling force without moving.
- B. Support raceway by straps, suitable clamps or hangers to provide a rigid installation. Perforated strap hangers and twisted wire attachments will not be acceptable. Do not support or fasten raceways to other pipe or in a manner to prevent the ready removal of other pipe.

2.08 GROUNDING

- A. Conform to NEC Article 250.
- B. Ground Wire: Color coded green, copper conductor, with insulation same as circuit or feeder conductors.
- C. Grounding Conductor: Provide green insulated equipment grounding conductor or circuit grounding conductor per NEC 250 in raceway system. Insulation and conductor type shall be the same as circuit conductors.

PART 3 – EXECUTION

3.01 RACEWAY

- A. IMC and EMT: Interior areas.
- B. RGS: Exterior area with approved weatherproof fittings.

- C. PVC: Exterior underground with RGS factory-radius elbows transitioning above ground.
- D. Flexible Conduit: Flexible metal conduit located in wet locations, mechanical room, kitchen areas, shall be liquid-tight type. A maximum of 72" of flexible metal conduit shall be used for the connection to motors and vibrating equipment, final connection to lay-in light fixtures. Flexible metal conduit shall be continuous grounding type and provide with grounding lug per spec. No flexible conduit allowed for any concealed installation.
- E. Minimum Sizes: Conduit sizes are not necessarily specified on Drawings. Provide a minimum 1/2" conduit branch circuits and minimum 3/4" conduit homeruns and multi-pole circuits. Refer to other specification sections for other minimum sizes. Contractor shall provide sizing of conduits as required to meet code where the above specified minimum sizes are too small to afford 40% fill. Conduit sizes shall be sized for conductor types and sizes per NEC.
- F. Conduit termination shall have code-sized junction box for flush or surface installation. Conduit stubs shall have nylon insulated type bushing.
- G. Pull Wires: Provide pull wires in all empty raceways. Pull wires shall be continuous in each raceway run and extend a minimum distance of 12" from the junction box or terminal at the end of the raceway.

3.02 INSTALLATION

- A. One-line diagrams, risers, and conduit routing are schematic and do not show exact arrangement of equipment.
- B. Where indicated on Drawings, junction boxes and pull boxes are minimum requirements. Provide other fittings and pull boxes of adequate size in the raceway system wherever necessary or required by the NEC. Allow a maximum of four 90-degree bends between pull boxes in each run of conduit.
- C. For root-top conduit installation, provide expansion joint fittings and Firestone rubber blocking (to match existing where applicable) and assemblies.
- D. Provide expansion joint fittings for conduits passing through new or existing expansion joints. Verify exact locations and details of expansion joints prior to work.
- E. Coordinate conduit routing, pull box and equipment locations with other trades to avoid conflicts of equipment installations. Empty conduits shall have pull wires.
- F. Conceal all raceways except as permitted by Architect.
- G. Where permitted, exposed raceway shall be run parallel or perpendicular to the building. Run raceways as high as possible, unless noted otherwise.

- H. Carefully form bends to avoid injuring or flattening raceway. Raceways 1-inch trade size and larger shall utilize factory formed fittings where bends are 45-degrees or larger. Minor offsets are permitted to be filed bent. All bends in conduits serving low-voltage systems shall not have bend radii less than 10-times the nominal conduit size.
- I. Support raceways with heavy-duty, one-hole, pressed steel straps on interior surfaces. Support pendant mounted raceways on 1/4" rod with pear-shaped hanger (up to 2" pipe size) or trapeze type hanger with 3/8" rod, 1-5/8" square preformed channel. Conduit support system shall be dedicated and isolated from other systems and ceiling supports or tees. Conduit installations shall not use ceiling type wire and clips as support system.
- J. Anchor all electrical work securely to structure using fasteners approved by a Washington State Licensed Structural Engineer for the types of structure encountered.
- K. Anchor to frame structure by means of sheet metal screws. Fasten to structural walls with lead anchors or steel expansion shells and threaded bolts or screws with slotted heads. Fasten to architectural or masonry walls with toggle bolts or molley screws. Deviation from these methods must be approved prior to installation.
- L. Furnish anchor bolts and anchorage items as required, and field check to insure proper alignment and location. Provide templates, layout drawings, and supervision at the job site to ensure correct placing of anchorage items in concrete. Check embedded items for correctness of location and detail before concrete is placed.
- M. Control erection tolerance requirements to not impair the strength, safety, serviceability, or appearance of installations, as approved by the Engineer. Determine exact location of conduit. Route all conduit parallel to building lines.
- N. Hot-dip galvanize all exterior support hardware after fabrication.
- O. Install individual conductors in conduits, raceways, ducts, and trenches to complete the wiring systems.
- P. Install switches and cover plates complete in a neat manner in accordance with the NEC and local codes.

3.03 WIRE AND CABLE

- A. Branch circuits shall be #12 AWG minimum.
- B. Branch circuit wiring size #10 AWG and smaller shall have continuous color code identification per standard listed below. Tin all stripped ends of wiring #10 AWG and smaller prior to termination under set screws.

- C. Use no mechanical means for pulling wires, and no lubricant except powdered soapstone or approved substitute.
- D. Branch circuit splices may be made with 3M Scotch-Lok Electrical Spring type connectors up to #8 AWG size, except motor connections.
- E. Utilize crimp-type pressure connectors insulated with tape or pre-fabricated covers on motor connections and splices of wiring #6 AWG and larger.
- F. Make no splices in home runs.
- G. Do not inter-mix wiring from separate raceway systems unless specifically permitted by the Engineer.

H. Color Coding Standards:

3Ø, 4 Wire System:	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

Control Wiring: Grey or black with identifying wire numbers at each termination

Color-coded Tape: May be used in lieu of color-coded insulation for conductors #8 AWG and larger. However, the insulation shall be black only and shall be tape-identified with color scheme shown above at splices, terminations and junction boxes.

- I. Each single pole branch circuit shall contain a dedicated neutral conductor and equipment grounding conductor of the same size as the hot conductors. Shared neutral conductors and/or multi-pole breakers used on single pole loads are not permitted.
- J. All wiring shall be identified with permanent wire labels, using alphanumeric designations. All terminations and splices shall be identically labeled for the same wire (i.e. common conductors terminated in multiple locations). Wire labels shall agree with the circuit designations on the as-built drawings. Provide Thomas and Betts, Brady, or equal, printed plastic adhesive tapes to show circuit numbers. Wrap tapes at least two turns around conductor.
- K. Identify conductors in outlets, pullboxes, and similar locations where conductors are accessible.
- L. Conductors in panels, cabinets, and enclosures: Provide neat and workmanlike installation with conductors tied with T&B Ty-Rap, or equal, nylon wire ties.

Provide adhesive back nylon Ty-Rap 4-way bases (#TC200X200AX or equal) to group conductors in neat and orderly manner.

- M. Low voltage wiring and cables specified herein by Divisions 26, 27, or 28 shall be installed either in complete raceway system or shall be plenum rated.

3.04 WIRING DEVICES

- A. Installation: Install two or more wiring devices shown in one location under a common plate. Install plates with edges in continuous contact with finished wall surfaces. Do not install more than one device in single-gang position.
- B. Device Locations: Device or equipment mounting height given herein the Specifications, Contract Drawings, and/or documents are intended to provide general guidelines. Provide pre rough-in coordination and verification with other divisions. Verify that the intended mounting heights are appropriate for the intended device use, and the device location is not in conflict with other components.
- C. Prior to rough-in, devices and equipment locations may be revised by the Owner's Representative within 20' of the designed contract location, at no cost. Prior to rough-in, confirm locations with Owner for devices they may wish to have relocated from the location indicated on the contract drawings.
- D. If the contractor fails to provide such coordination and field verification and results of erroneous installation, the contractor shall remedy such installation per Owner Representative's direction, at contractor's cost.
- E. Provide GFCI protection for receptacles requiring GFCI protection per NEC Article 511.
- F. Mount wiring devices above finished floor to centerline of device as follows, unless noted otherwise or as directed by Owner's Representative. Coordinate with Owner's Representative for possible interference with decorative features, art displays, etc.
- | | |
|---------------------------------------|---|
| Switches | 42-inches |
| Receptacles, Telecom Outlets | 18-inches |
| Receptacles Above Counter | 6-inches to CL above backsplash or as directed |
| Fire Alarm Pull Stations, Wall Phones | 42-inches |
| Fire Alarm Audio Visual Devices | 80-inches (or 6" below ceiling), whichever is lower |
| Receptacles (in Classified Areas) | 24-inches (above finished floor and below ceiling) |

3.05 BOXES

- A. Support boxes securely and independently.
- B. Mount boxes on building surfaces or support with trapeze hanger.

- C. Do not use junction boxes unless the number of bends, pulling length or circuit requirement necessitates their installation.
- D. Junction or pull box openings must be accessible.
- E. Do not use extension rings to provide Code size space within a new junction box. Provide larger junction boxes as required in lieu of extension rings.
- F. Do not intermix raceways and wiring at common junction boxes except at terminal equipment connections.

3.06 GROUNDING

- A. General: Provide system and equipment grounding in accordance with the applicable codes and ordinances and as further amplified on the Drawings.
- B. Ground service equipment, separately derived systems, conduits, devices and equipment in accordance with NEC, Article 250.
- C. Grounding Conductor: Provide green insulated equipment grounding conductor in conduits containing wiring systems above 50 volts. Insulation and conductor type shall be the same for circuit or feeder conductors. Size conductors in accordance with NEC Article 250.
- D. Bonding: All conduit systems shall be effectively grounded and bonded together by approved bonding means in accordance with the NEC. Verify ground continuity between conduits, boxes, receptacles, and equipment.
- E. Inspection: Place no backfill around grounding system until it has been inspected by the Engineer, Electrical Inspector, and Owner's Representative.

END OF SECTION

SECTION 27 08 00

COMMISSIONING OF COMMUNICATIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Provisions and Specification Sections, apply to this Section and other Sections of Division 27.
- B. This Section relates to the Structured Cabling Sections of this Specification.

1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for the structured cabling system and inter-building distribution systems. It includes terminations and testing parameters. Reference individual sections for further expansion of these requirements.
- B. Codes: The cabling system installation shall comply fully with all local, county, and state laws, ordinances, and regulations applicable to electronic and electrical installations.
- C. The following industry standards are the basis for the structured cabling system described in this document:
 - 1. This Technical Specification and Associated Drawings.
 - 2. ANSI/TIA/EIA-568-B series, Commercial Building Telecommunications Cabling Standard, and its published addenda.
 - 3. ANSI/TIA/EIA 568-C.0, Generic Telecommunications Cabling for Customer Premises, and its published addenda.
 - 4. ANSI/TIA/EIA 568-C.1, Commercial Building Telecommunications Cabling Standard, and its published addenda.
 - 5. ANSI/TIA 568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components.
 - 6. ANSI/TIA/EIA 568-C.3, Optical Fiber Cabling Components Standard, and its published addenda.
 - 7. ANSI/TIA/EIA-569-C, Commercial Building Standard for Telecommunications Pathways and Spaces, and its published addenda.
 - 8. ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, and its published addenda.
 - 9. ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, and its published addenda.

10. Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM).
 11. ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers, and its published addenda.
 12. NFPA 70 – National Electrical Code (NEC)
 13. ISO 11801 Generic Cabling for Customer Premises
- D. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
- E. This document does not replace any codes, either partially or wholly. The contractor must be aware of local codes that may impact this Project.

PART 2 – PRODUCTS

2.01 APPROVED TESTING PRODUCTS

- A. Copper:
1. Fluke DXP.
 2. Any other tester must be approved by the Owner and Engineer.
- B. Fiber:
1. Optical Time Domain Reflectometer (DTR).
 2. Optical Loss Test Set (OLTS).
 3. Any other tester must be approved by the Owner and Engineer.

2.02 QUALITY ASSURANCE PARAMETERS

- A. All work shall be performed in accordance with these guidelines, current industry testing standards, and with the test equipment manufacturer recommendations. All work shall be in accordance with the general principles outlined in the BICSI TDMM manual, the latest edition.
- B. All equipment or apparatus of any one system must be the product of one manufacturer, or approved equivalent products of a number of manufacturers that are suitable for use in a unified system.
- C. All materials and equipment for which Underwriters Laboratories have established standards shall bear a UL label of approval.
- D. Where proprietary names are used, whether or not followed by the words “or as approved”, they shall be subject to substitution only as approved by the Technology Consultant/Engineer.

- E. Where the Contractor proposes substitute equipment, the Contractor shall submit acceptable evidence to indicate compliance with all requirements of the documents, including performance ratings, size, and resistance to wear and deterioration equivalent to the specified item. In instances where substituted equipment requires additional material or work beyond that shown or required by the specified item, said additional material or work shall be the responsibility of this Contractor, regardless of the trade involved.

PART 3 – EXECUTION

3.01 UTP CABLE TESTING

- A. Riser distribution cable testing: Each cable pair within all UTP riser cables shall be tested for continuity to ensure conductors are terminated in proper sequence, with correct polarity (tip and ring), and without conductor-to-conductor shorts, conductor-to-ground shorts, or opens.
- B. Horizontal cable testing: All UTP station cables shall be tested to prove compliance with the current industry standard, TIA-568-B.2-1 Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100Ω Category 6(6A) Cabling and any subsequent addenda. Channel tests are the only acceptable test format for testing Category 6A cabling. Link tests will not be sufficient.
- C. Horizontal cable testing equipment: The testing of UTP station cables shall be performed using the recommended test equipment specifically designed to test cables for all Category 6(6A) parameters from 0-250 MHz. Testers shall be loaded with the most recent test values per the above referenced standard. The contractor may be required to provide documentation (or demonstration) that the testers used are properly programmed as described above.
- D. The field test equipment shall meet the requirements of TIA-568-B including applicable Technical Service Bulletins and amendments. The appropriate level III tester shall be used to verify Category 6(6A) cabling systems.

3.02 FIBER OPTIC CABLE TESTING

- A. Fiber Optic cable testing requirements:
 - 1. Test multi-mode strands at 850 nm and 1300 nm.
 - 2. Test single-mode strands at 1310 nm and 1550 nm.
 - 3. Use optical time domain reflectometer (OTDR) for tests.
 - 4. Record signature trace, length, and attenuation.

3.03 TEST RESULTS

- A. Submission: Prior to acceptance, the Contractor shall submit a copy of all applicable test results to the Owner/Technology Consultant/Engineer in both electronic (file) and paper form.

- B. Category 6(6A) UTP cables: The test results submitted for Category 6A UTP cables shall include the following:
 - 1. Graphical/numerical data: Both graphical data plots and numerical data are required for the following test parameters:
 - a. NEXT
 - b. PS NEXT
 - c. ELFEXT
 - d. PS ELFEXT
 - e. Attenuation
 - f. Return Loss
 - g. Numerical Data: Numerical data is only required for the following test parameters:
 - 1) Propagation delay
 - 2) Delay skew
 - 3) Resistance
- C. UTP Riser Cables: Continuity tests shall be performed on each pair. The Contractor shall submit a document confirming that these cables were tested satisfactorily per these guidelines.
- D. Fiber Optic Cables: Test results for fiber optic cables shall consist of the measured attenuation, the maximum attenuation allowed per these guidelines, and whether the test passed or failed for each fiber optic cable link.

3.04 SYSTEM DOCUMENTATION

- A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Technology Consultant/Engineer a complete set of documents that clearly represent all Contract work "as-builts". These shall be inclusive of all test results and Drawings. The Contractor is responsible for assuring the accuracy of the As-Built Documentation.
- B. The Contractor shall submit, within forty (40) working days of the completion of each phase, three (3) full sets of As-Built Documentation to the Technology Consultant/Engineer for approval. Prior to delivery, each document section and each drawing shall be signed and dated by the Contractor's Project Manager attesting to the accuracy of the As-Built Documentation.
- C. Electronic drawing files must conform to project drawing standards and be in AutoCAD 2012 (minimum) format. The As-Built Drawings shall include at minimum, equipment locations, cable routes, and outlet locations. They shall also clearly show any deviations from the Contract Documents.
- D. Note – The Technology Consultant/Engineer is under no obligation to provide the Contractor with digital drawing files. However, digital drawing files may be provided to the Contractor for use in development of Shop Drawings or As-Built Drawings under a separate agreement between the Contractor and the Architect.

- E. Test printouts and electronic files generated for each cable by the wire (or fiber) shall be submitted as part of the documentation package. The electronic files shall contain the electronic equivalent of the test results and be of a format readable from Microsoft Word or Excel.
- F. The As-Built Drawings shall include outlet locations. Their sequential numbering, as defined elsewhere in this document, shall identify outlet locations. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. These documents shall be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Technology Consultant/Engineer.
- G. The Technology Consultant/Engineer may request that a 3% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications Contractor, additional testing can be requested to the extent determined necessary by the Architect or Technology Consultant/Engineer, including a 100% retest. This re-test shall be at no additional cost to the Owner.
- H. Test results documentation shall be clearly marked on the outside front cover with the words "Project Test Documentation" and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, and reference setup. The test equipment name, manufacturer, model number, serial number, software version, and calibration date shall also be provided at the end of the document. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- I. When repairs and re-tests are performed, the problem found and corrective action taken, shall be noted, and both the failed and passed test data shall be documented.

END OF SECTION

SECTION 28 23 00

VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.01 SCOPE & RELATED DOCUMENTS

- A. The work covered by this Section and Specifications includes the furnishing of all labor, equipment, materials and performance of all operations in connection with the installation of the IP Video Surveillance System (IPVS) or Closed Circuit Television System (CCTV) as shown on the drawings and as herein specified. Conform to General Conditions, Supplementary Conditions and Division 1.
 - 1. Contractor to provide a functioning camera system incorporating exterior fixed cameras and Network Video Recorders (NVR) with the capability of on-site and remote monitoring.
- B. Work covered by this Section of the Specification shall be coordinated with the related work as specified elsewhere under the project specifications.
- C. Project Scope:
 - 1. Contractor shall provide cameras and programming per this spec and as shown on drawings.

1.02 RELATED REQUIREMENTS

- A. Division 26 Section - Common Work For Electrical Systems.
- B. Division 26 Section - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- C. Division 26 Section - Hangers and Supports for Electrical Systems.
- D. Division 26 Section – Raceway and Boxes.
- E. Division 27 Section – Pathways for Communications Systems
- F. Division 27 Section – Operation and Maintenance of Communications Systems
- G. Division 27 Section – Basic Materials & Methods for Communications Systems
- H. Division 27 Section – Grounding and Bonding of Communications Systems
- I. Division 27 Section – Commissioning of Communications

1.03 GENERAL

- A. Furnish and install a complete IPVS as described herein and as shown on the plans; to be wired connected and left in first class operating condition. The system shall use Category 6 cabling.
- B. IPVS system shall be listed with UL for power limited circuit use and shall have a minimum of 2-hour UPS battery backup.
- C. Location of the NVR and POE switches shall be installed within wall mounted rack.
- D. Equipment submissions must include a minimum of the following:
 - 1. Complete descriptive data sheet indicating UL listing for all system components.
 - 2. Complete sequence of operations diagrams of the system.
 - 3. Complete system wiring diagrams for components being connected to the system and interfaces to associated equipment.
 - 4. Mandatory pre-installation meeting with Technical Representative, General Contractor, and subcontractors to discuss scope of work and duration of project.

1.04 SYSTEM OPERATION

- A. System shall be comprised of IP fixed cameras as shown on the drawings.
- B. NVR should have the capability of a minimum of 10 IP cameras leaving room for additional 5 cameras to be added to the system at a later time.
- C. Provide all equipment to provide access to video local. This is for maintenance of the IPVS cameras on site. The NVR will have the capability of being view through a LAN / WAN.

1.05 QUALITY ASSURANCE

- A. Request for substitutions of equal to equipment must be received in accordance with Section 00100.
- B. The system supplier shall be a company specializing in the installation, integration, and supply of IPVS, fire and access control systems with at least 5-years of experience and shall have local employees available for support during installation and for final hook-up and acceptance testing. Contractor shall produce system specific layout and wiring shop drawings.
- C. Provide factory and state certifications (journeyman) of the people that will be performing the final hookup and programming of the IPVS system in the submittals.

- D. Contractor must be qualified/certified on all provided platforms (including PTZ cameras).
- E. Contractor must be able to reference prior experience/projects where they have used PTZ cameras.
- F. Contractor shall be able to supply a secure web based user portal to provide real time information on request for proposals, service work orders, reporting and access to an information repository. Portal shall not require use of a prescribed web browser or downloading of a proprietary application. This portal shall also have the capability to assist MRJC in developing NERC compliance guidelines and documentation.

1.06 RACEWAY AND WIRING SYSTEM

- A. Contractor to provide all circuit wiring and raceway conduits as required. Refer to electrical plans, Division 26, 27, and spec 28 23 00.
- B. Contractor to provide the required raceway conduits and wiring system necessary for the installation of the IPVS system. Install IPVS system wiring in a complete raceway system per code requirements. Provide cutting, patching, finish work, clean up, etc., necessary to accomplish work.
- C. IPVS contractor to provide all equipment hookups, trim, labeling, and cable testing as required.

1.07 PRODUCT DATA

- A. Prior to assembling or installing the system, the Contractor shall provide the following:
- B. Complete product data and technical specification data sheets that include manufacturer's data for all material and equipment, including terminal devices, local processors, computer equipment, IPVS, and any other equipment provided as part of the system.
- C. A system description, including analysis and calculations used in sizing equipment required by the system. The description shall show how the equipment shall operate as a system to meet the performance requirements of the system. The following information shall be supplied as a minimum:
 - 1. Central processor configuration and memory size.
 - 2. Description of site equipment and its configuration.
 - 3. Protocol description.
 - 4. Rigid disk system size and configuration.
 - 5. Backup / archive system size and configuration.
 - 6. Startup operations.
 - 7. System expansion capability and method of implementation.
 - 8. System power requirements and UPS sizing.
 - 9. A description of the operating system and application software.

10. Factory and State Certifications.
11. Test matrix to follow the function and integration of each devices and systems.

1.08 SUBMITTALS

- A. Prepare and submit shop drawings and catalog cut sheets for approval within the time period as stated in the General Conditions. Contractor shall not start any construction or order any materials prior to acceptance and approval of all submittals. Partial submittals are unacceptable. Submittals, as a minimum, shall include the following:
 1. Specification data sheets on each individual system component.
 2. Floor plans drawn with same size and scale as the Contract Drawings. Drawings shall indicate device locations, ID number, raceway/wire routing, riser diagrams, conduit and wire size, wire identification numbers, room and floor identification numbers.
 3. NVR Server Bandwidth and Storage calculations.
 4. Point to point wiring diagrams of the control panels, remote monitors(s), PoE switches, and terminal cabinets showing all installed wiring (not factory wiring harnesses) and connection of all field wiring to the units.
 5. Detailed mounting installation diagrams of the control panel(s), remote work station(s), and camera(s).
 6. Riser diagrams with circuit identification labels, terminal wire identification, conduit and wire size, and device ID number and locations (with room names and numbers).
 7. Operational description of the system, or a schematic ladder type logic diagram.
 8. Matrix of video cameras with identification number, type, location, connection type, power requirements, and blank row spaces for MAC addresses, IP Addresses, Firmware Revisions, and test access control integration.
 9. VMS software shall be configured for mapping Graphic User Interface (GUI) video work station video graphic layout screens shall be the following:
 10. IPVS cameras and ID numbers ICON's.
 11. IPVS Radar and ID numbers ICON's.
 12. Building, Rooms, and floor identification numbers import graphic from .bdg, .jpg, or .dxf files.
 13. PTZ zone levels shall be a part of screen graphics.
 14. All new and existing devices.
 15. All video screens shall be setup and approved by owner prior to final inspection.
 16. The contractor shall provide current state and factory trained certificates of technicians assigned for this project.

1.09 CONSTRUCTION DRAWINGS

- A. While the system installation is in progress, one set of shop drawings will be kept at the job site. This set will be designated as the construction drawings and will

be updated each working day to reflect current as-built information. One set of construction drawings can be replaced with a fresh updated set of drawings but there shall never be more than one active set of construction drawings. The Technical Representative shall be given access to this set of construction drawings at all times so that progress may be reviewed and copies may be made. At the end of the project these marked-up construction drawings shall be submitted as part of the as-built drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Video Surveillance System (IPVS) equipment shall consist of a system assembled as an approved unit of regularly manufactured components, by a single manufacturer for the purposes described elsewhere in this specification. Interconnecting equipment that has not been listed for interconnection or the creation of components or system into a non-standard unit that is not normally available from the manufacturer is not acceptable.
- B. Providing they meet all specifications, control panels and related equipment shall be manufactured by Video Surveillance Management System or compatible with Video Surveillance Management System.
- C. Request for substitutions of equal to equipment must be received in accordance with Section 00100.
 - 1. Axis
 - 2. Samsung(Hanwha)
 - 3. Or approved equal.

2.02 VIDEO MANAGEMENT SYSTEM DESCRIPTION

- A. The Video Management System (VMS) software shall be used to view live and recorded video from IP devices connected to local and wide area networks. The VMS software shall have a client/server-based architecture that can be configured as a standalone VMS system with the client software running on the server hardware and/or the client running on any network-connected TCP/IP workstation. Multiple client workstations shall be capable of simultaneously viewing live and/or recorded video from one or more servers. Multiple servers shall also be able to simultaneously provide live and/or recorded video to one or more workstations.
- B. The VMS shall not charge for the number of concurrent clients.
- C. The integrator shall supply a video management system using software current version. The system will consist of cameras, enclosures, heaters/ blowers if required, Cat6 wiring, POE network switches, core network switches, and required software. The integrator shall also develop specification for the NVR server and submit this to owner.

- D. The VMS system shall utilize manufacturer built servers, commercial-off-the-shelf (COTS) computer workstations, servers, networking devices and storage equipment.
- E. Recording of all video transmitted to the VMS shall be continuous, uninterrupted and unattended.
- F. The VMS system shall offer the capability of video motion detection recording, such that video is recorded when the NVRMS detects motion within a region of interest of the camera's view. Video prior to the detection of the motion shall also be stored with using the pre-recorded feature.
- G. The VMS system shall manage the video it has been configured to monitor. Loss of video signal shall be configured to annunciate on VMS client by an on screen visual indication alerting operators of video loss.
- H. The VMS software shall have an open architecture supporting IP cameras and encoders from multiple manufacturers providing best-of-breed solutions ranging from low-cost, entry-level features to high-resolution, megapixel features.
- I. The VMS client software shall be able to view live video and audio, recorded video and audio, and be able to configure the complete system all from a single application.
- J. The VMS shall continue to record video and audio at all times during the administration and configuration of any feature.
- K. The VMS client software shall add and remove features based on the permissions of the user and the licensed functionality.
- L. The VMS software shall allow the user to have any combination of VMS client applications running on any of the supported operating systems be able to connect to any of the VMS servers running on any of the supported operating systems. For example, a VMS client running on Microsoft Windows shall be able to simultaneously connect to four (4) different VMS servers all running on different operating systems, such as Windows Server, and Linux.
- M. The VMS software shall have the capability to run multiple client applications simultaneously on one workstation with multiple monitors.
- N. The VMS shall also allow an authorized user to view video through a web client interface. The web client interface shall allow authorized users to view live video; view recorded video, control pan-tilt zoom (PTZ) cameras and activates triggers. The web client interface shall allow connections to multiple VMS servers simultaneously.
- O. The web client interface shall operate without requiring installation of any software.

- P. The VMS server software shall record and retrieve video, audio and alarm data and provide it to the VMS clients upon request.
- Q. The VMS shall license the total number of cameras on the system. This license shall be based on the MAC address of a single network card that is present on the system. The VMS shall only require that this network card be enabled and does not require that data is actually sent through it.
- R. The VMS shall not require the manufacturer to be contacted when a camera fails.
- S. The VMS server software shall run as a service. The VMS shall not require any application to be running in order to operate.
- T. The VMS shall allow the use of maps. The maps will be accessible to users with the appropriate permission levels and display video sources and their status.
- U. The VMS allows soft triggers to be placed, viewed and triggered from a map.
- V. The VMS shall support the use of a panoramic lens on an analog or IP camera. The VMS client shall de-warp the image on both live and recorded video.

2.03 CERTIFICATIONS

- A. CE and FCC, A and B (all models).

2.04 MANUFACTURE WARRANTY

- A. Minimum 3-year warranty on parts and labor and a 3-year Software Subscription Agreement (SSA).

2.05 VIDEO MANAGEMENT SYSTEM HARDWARE (VMSH)

- A. Contractor to calculate and provide NVR as required per the count on the electrical plans add 10% future cameras.
- B. The NVR minimum requirement for video storage and archiving:
 - 1. Recording cameras at min. 15 frames per second (F/s) saved as H.264 and MPEG-4. At this setting, each camera will require 18GB of active file space each day.
 - 2. Size memory drives to accommodate application base operating, disc management software and active video file storage needs. Provide one drive segment for redundancy based on 15% of active file need. In addition, provide one drive segment for hot spare based on 15% of active file need. Size each segment by rounding up to the nearest whole terra byte, all drive segments are equal in size.
 - 3. The four (4) weeks of raw video recording will be stored without any changes.
 - 4. The next five (5) weeks after will be archive 25% compression.
 - 5. The next Six (6) weeks after will be archive 50% compression.

6. This will give (4) weeks of raw video and 2 months of compression video storage.
 7. All Camera recording will rollover after memory is full.
 8. Provides a recording server with 16 Terabyte (TB) of file storage capacity, which will store 30 days of video for 29 cameras.
- C. Provide NVR server as requirements by these above calculations and manufacture specifications.

2.06 APPROVED CAMERA MANUFACTURES

- A. All video surveillance cameras have to be fully compatible with Video Surveillance Management System.
1. Bosch
 2. Pelco
 3. Samsung(Hanwha)
 4. ACTi
 5. Axis
 6. FLIR (Thermal only)
 7. Or approved equal.

2.07 EXTERIOR FIXED CAMERAS

- A. IP Exterior cameras installed on exterior walls shall be a traditional camera chassis body and use a varifocal lens to capture the best image in the desired area. Camera should have a low light day / night capacity with the ability to be powered by CAT 6 cabling. Day night mode should switch automatically from color to monochrome to provide enhanced IR-Sensitive.
- B. Provide all required mounting bracket, enclosures, and lenses for these cameras.
- C. Camera features:
1. High impact, vandal resistant housing.
 2. Superrb video in 10MP quality.
 3. P-Iris control
 4. Multiple H.264 streams and Motion JPEG video streams
 5. Day and Night capacity / Optional Color at night
 6. Exterior –ready, IP66 and NEMA 4X rating.
 7. RJ45 Connection
- D. Camera Model:
1. Exterior IP Fixed Dome Camera Hawwha XNV-9082R.
 2. or other reviewed and approved Manufacturers.

2.08 CAMERA LICENSES

- A. Provide camera licenses as required.

2.09 VIDEO RECEIVER

- A. Model: IFS VR2100 (fixed cameras) or equal.

2.10 CAMERA ENCODER

- A. 8-camera outputs or equal.

2.11 IPVS SYSTEM MONITOR

- A. Features
 - 1. 1280 x 1024 resolution.
 - 2. Active matrix TFT.
 - 3. .264 height x 0.264 vertical.
 - 4. One (1) Flat Screen LED 32" ASUS 328Q or better.

2.12 POWER SUPPLIES

- A. Interior
 - 1. RJ45 connection, POE will be a four (4) & eight (8) channel power supply switch hub with two (2) fiber connections. POE must be rack mountable. Model: Planet IGS-10020HPT or approved equal. (Base of design)
- B. Exterior
 - 1. RJ45 connection, POE will be a four (4) & eight (8) channel power supply switch hub with two (2) fiber connections. POE must be rack mountable. Model: Planet IGS-10020HPT (inside NENA-4 or 4X Cabinet Mount) or approved equal. (Base of design)
 - 2. Provide power supply for heat & blower in exterior cameras should be a single output 4 AMP 24V AC transformer or approved equal. Provide 120VAC outlet inside the building above drop ceiling.
 - 3. Model: Altronix R248ULCBDM (Rack Mount) or approved equal.
 - 4. Model: Pelco WCS1-4, 4-port (wall or pole) or approved equal. Replace cabinet lock & key to match AMAG Card Access Control cabinets.

2.13 FIBER EQUIPMENT

- A. Interior Fiber Patch Panel
 - 1. Provide 12-port fiber patch panel. Fiber patch must be rack mountable. Model: FS or approved equal. (Base of design)
- B. Interior Fiber Switch
 - 1. Provide 12-port fiber switch. Fiber switch must be rack mountable. Model: Cisco, HP, FS or approved equal. (Base of design)

2.14 RACK

- A. Use spare in new rack as shown on electrical communication details plans.

2.15 CAT6 CABLE REQUIREMENTS

- A. Contractor to provide a minimum of one (1) CAT6 cable (max run of 285 feet) to each camera. All CAT6 cable shall be plenum rated cable unless stated otherwise.

2.16 FIBER CABLE REQUIREMENTS

- A. Fiber Optic Cable
1. Installed cable shall be 62.5/125micron core/cladding, enhanced grade, multimode, and graded index glass fiber. All materials in the cable shall be dielectric. Homerun each cable from camera to encoder.
 2. Installed fiber must meet or exceed the following performance specification.

Wavelength (nm)	Max. Attn.(dB/Km)	Min. Bandwidth (Mhz)
850	3.0	200
1,300	0.9	500

- B. Inside Fiber cable
1. Tight buffered 900 um, mechanically strippable Teflon, plenum rated.
 2. EIA/TIA -598 color coding for fiber optic cable.
 3. Aramid yarn strength member, capable of supporting a short-term tensile load of 400 lb. without stretching.
 4. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
 5. Capable of a minimum crush resistance of 850 lb./in.
 6. Installed fiber must meet or exceed the following performance specification.
- C. Outside Plant Cable
1. Use outside plant cable for all applications where cable is to be run in conduits.
 2. Gel filled buffer tube, 250 um, acrylate. Flooded core
 3. EIA/TIA-598 color coding for fiber optic cable.
 4. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
 5. Capable of a minimum crush resistance of 850 lb./in.
- D. Installation
1. Protect underground inter-building fiber cable with inner duct.
 2. After installation, inner ducts are to be permanently labeled as containing fiber optic cable.
 3. Fully support cable and inner duct throughout its entire run.
 4. Pull fiber cable using only hand power. At no time shall more than 400 pounds of tension be placed on any fiber cable while it is being pulled.
 5. Avoid torsion by the use of a swivel at the cable end.

6. While under tension, maintain a minimum bend radius of 20 times the outside cable diameter. Use pulleys and sheaves where required.
 7. After pulling, no bend may have a radius, at rest, of less than 10 times the outside cable diameter.
- E. Labeling
1. Label each cable and inner duct at each end with a unique cable number.
 2. Affix labels to the cable/inner duct at every transition of a vault, hand hole, riser closet, or major pull box.
 3. Label each fiber optic strand at the ST coupler in the enclosure.
 4. Connectors shall be labeled on the identifying sheets on the front of the enclosure.
 5. Label each fiber where it enters the back of the coupler panels.
 6. At each end of the cable, sufficient slack (15 - 30') shall be left to facilitate reasonable future relocation of the FIC. Slack shall be mounted on walls or upper ladder racks.
- F. Termination
1. Terminate both ends of all fibers within a fiber cable in the field using hot melt ST type connectors.
 2. Mount connectors on bulkheads and install in approved enclosures.
- G. Fiber Organizers
1. Terminate fiber cables in either wall-mounted or rack-mountable stand-alone enclosures. Rack mounted units made by ADC, Avaya, or an equivalent is acceptable.
 2. Label each enclosure using a machine made label, permanent black ink on a white background.
 3. Label each fiber optic strand with a unique identifier at the ST coupler. Connectors shall be labeled on the identifying sheets on the front of the bulkhead enclosure.
 4. Label each fiber where it enters the back of the coupler panels
- H. Testing and Inspection
1. Test each individual fiber in a cable with an OTDR for length and transmission anomalies while on the reel before installation.
 2. Test all multi-mode and single-mode fiber strands end-to-end for bi-directional attenuation following installation and termination.
 3. Conduct tests in accordance with EIA/TIA-526-14 or OFSTP 14, Method B, and cable manufacturer's instructions for the test set being utilized.
 4. The measured link loss for each strand shall not exceed the "worst case" allowable loss, defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss of 0.75 dB per mated pair) and the optical loss.
 5. The maximum allowable attenuation for splices or termination is 0.3 dB.
 6. Inspect the end faces of field terminated connectors with a fiber inspection scope (100X). Reject connector end faces with hackles, scratches, cracks, chips and or surface pitting. Re-polish end face surfaces or replace the connector to remove end face surface defects.

2.17 NAMEPLATES AND LABELS

- A. Manufacturers:
1. Marking Services, Inc. (MSI): <http://www.markserv.com>.
 2. Double O Laser Services, Inc. <http://www.doubleolaser.com>.
 3. Or other reviewed and approved Manufacturers.
- B. IP Video Surveillance (IPVS) Nameplates: Engraved plastic, high contrast for maximum visibility. 1/16" engraving plastic with mounting adhesive backing.
1. Video Surveillance Camera (IPVS) Locations: White letters on Blue 1"x3" plate with 1/2" letters.

Description:	Example:
Device Name:	IPVS 06

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide all equipment, wiring, conduit and outlet boxes required for the installation of a complete and operating system in accordance with applicable local, state and national codes, the manufacturer's recommendations, these plans and specifications. All circuits not in conduit must be wired with UL listed power limited cable under NEC 725 Class II wiring. Plenum cable shall be utilized in all return air plenum ceilings. All other types of wiring must be in a separate conduit system. Color coded wires shall be used throughout. Wiring shall conform to the National Electrical Code Article 725.
1. All equipment and wiring shall be guaranteed against defects in materials and workmanship for a one year period from the start up and beneficial use of the system. Warranty service for the equipment shall be provided by the system supplier's factory trained representative during normal working hours, Monday through Friday, excluding holidays. Emergency service provide at times other than as stipulated above shall be available from the same source at additional cost to the owner.
 2. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- B. The contractor shall clean all dirt and debris from the inside and the outside of the video surveillance equipment after completion of the installation.

3.02 SUPERVISION

- A. The manufacturer shall provide all on-site supervision of the installation, perform a complete functional pre-test of the system and submit a written report with camera name and location to the contractor attesting to the proper operation of the complete system.

- B. Contractor to provide screen shot of each camera view after pre-test is done. Email these screen shots to general contractor that forward to owner security department for approval, prior to final test.
- C. Prior to final acceptance test the contractor shall provide the following documents:
 - 1. As-built drawings shall be full construction set with redline markups that contain the following (all identification number, MAC & IP address, new device conduit or wiring pathways, and exact location of devices and panels.)
 - 2. Provide a test matrix with identification number, type, location, MAC & IP address devices, and access control integration.
 - 3. Haft size graphic map of each floor with identification number, MAC & IP address devices. (No wire)
 - 4. Provide screen shots of each video camera.
 - 5. Provide CAT6 cable test reports for each camera per specification "Communications Copper Horizontal Cabling".
 - 6. Provide the VMS software configuration for mapping Graphic User Interface (GUI) of video work station video graphic layout screens as-built drawings of the following:
 - a. Radar and ID numbers ICON's.
 - b. IPVS cameras and ID numbers ICON's.
 - c. Building, Rooms, and floor identification numbers import graphic from .bdg, .jpg, or .dxf files.
 - d. PTZ zone levels shall be a part of screen graphics.
 - e. All new and existing devices.
 - f. All video screens shall be setup and approved by owner prior to final inspection.
 - 7. Provide all the above documents in O&M manuals binders and one (1) binder for Central Control Office.

3.03 TESTING

- A. UTP CABLE TESTING
 - 1. Test Method and Reporting: All UTP wiring will be certified to meet or exceed the specifications as set forth in the Link Performance Testing Specifications For Field Testing Of Unshielded Twisted-Pair Cabling Systems, TIA/EIA TSB-67 Level-II, for Category 6 links. Certifications will include the following parameters for each pair of each cable installed:
 - a. Wire map (pin to pin connectivity)
 - b. Length (in feet).
 - c. Attenuation.
 - d. Crosstalk (NEXT).
- B. FIBER OPTIC CABLE TESTING
 - 1. Test Method and Reporting: Contractor will test cable to OTDR Standards and furnish Owner with electronic copies of all test results with at least the following information:
 - a. Date of Test.

- b. Name of Test Personnel.
- c. Test Wavelength.
- d. Pulse Duration(s) and Scale Range(s).
- e. Index of Refraction.
- f. Fiber Cable Types and Parts Number.
- g. Fiber Tube and/or Fiber Strand Number.
- h. Direction of Test.
- i. Overall Distance in Meters.
- j. Attenuation dB or dBm.

C. OTDR DISTANCE AND ATTENUATION TEST

- 1. After placement of all inside and outside cable, prior to termination, Contractor will test each and every fiber strand in each and every cable in both directions, utilizing an OTDR for both distance (in meters) and attenuation's (dB/km). Contractor will measure the attenuation per kilometer at both 850 and 1300 nanometer wavelengths using an OTDR. The refractive index will be set and verified in writing and in a certificate of calibration within 60-days after NTP to the test.
- 2. Setting:
 - a. Refractive Index 1.4776 at 850 nanometers.
 - b. Refractive Index 1.4719 at 1300 nanometers.
 - c. Link Loss Calculation.

D. OVERALL LINK LOSS TEST

- 1. Contractor will perform an attenuation test on each and every fiber strand run in both directions for overall attenuation from end to end. Contractor will perform tests utilizing a stabilized light source and measuring the receive level with a power meter. Contractor will be required to document, in writing all tests performed. Conduct tests in accordance with EIA/TIA-526-14 or OFSTP 14, Method B, and cable manufacturer's instructions for the test set being utilized.
- 2. The measured link loss for each strand shall not exceed the "worst case" allowable loss, defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss will be 0.75 dB per connector plus applicable cable length loss).
- 3. The maximum allowable attenuation for splices or termination is 0.3 dB.
- 4. Inspect the end faces of field terminated connectors with a fiber inspection scope (100X). Reject connector end faces with hackles, scratches, cracks, chips and or surface pitting. Re-polish end face surfaces or replace the connector to remove end face surface defects.

E. The completed video surveillance system shall be fully tested by the contractor in the presence on the owner's representative. Upon completion of a successful test, the contractor shall so certify in writing to the owner and general contractor.

F. Upon completion of the installation, and after test and demonstration, the Contractor shall provide the Technical Representative a signed written statement of completion.

- G. Upon completion of the After final installation of all IPVS cameras contractor to provide a one (1) month report of recording times for each IPVS camera.

3.04 INSTRUCTION

- A. The equipment manufacturer shall provide, as part of this contract, a minimum of four, two-hour time periods for instruction of the personnel designated by the owner as to the correct operation of the system.
- B. The manufacturer's representative shall conduct all instruction sessions during which all maintenance and operational aspects of the system will be described and demonstrated to personnel selected by the Owner.
- C. O & M manual information regarding the system shall be turned over to the Technical Representative prior to the scheduling of the training session.
- D. Provide two 4 hours training sessions after final acceptance by NSD, after the system has been tested and inspected and after the record drawings and O& M manuals have been completed and accepted.
- E. Provide the remaining two sessions for follow-up and refreshing training after occupancy by the district. These sessions shall focus on staff questions and system operation confirmation.
- F. All training sessions shall be recorded on video for Owner future reference. Additionally, a written record of training meeting minutes shall be maintained and given to the Owner once each training session is complete.
- G. Training sessions shall not occur less than 30-days apart. This allows the owner time to familiarize themselves with the system and develop questions.
- H. All operational guidelines shall be given in written form in sufficient numbers so that all key personnel have operational instructions of programming, station use, and special features. Copies of these instructions shall be provided for permanent record in the operation manuals.
- I. The Owner shall be provided with record drawings showing at least the following:
 - 1. As-built conduit routing on a floor plan drawing.
 - 2. As-built system wiring diagrams showing the electrical interface of all components supplied.

3.05 WARRANTY

- A. The contractor shall warrant the completed video surveillance system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified test or from the date of first beneficial use.

- B. The equipment manufacturer shall make available to the owner a maintenance contract proposal to provide a minimum of two (2) inspections and test per year.

3.06 AS-BUILT DRAWINGS

- A. As-built drawings shall be provided by the Contractor which clearly indicates:
1. Actual routing of all raceways.
 2. Actual cable type, color, number, and routing.
 3. Actual IPVS camera IP address and serial numbers.
 4. Actual IPVS camera report with all configurations.
 5. Actual system wiring diagrams, connection diagrams and interface of all components in the system.

END OF SECTION

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SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This work includes site stripping and excavation, embankment, grading, earthwork for structures and foundations, earthwork for utilities, compaction, and disposing of excavated material.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 QUALITY CONTROL

- A. Soil Testing
 - 1. The Owner will engage a Geotechnical Consultant to test soil materials proposed for use in the work and for quality control testing during excavation and fill operations.
 - 2. Samples of materials shall be furnished to the Geotechnical Consultant by the Contractor at least two weeks before their anticipated use.
 - 3. Under this contract, smooth out areas for density tests and otherwise facilitate testing work as directed.
- B. Shoring Systems: Pre-engineered systems, cleared labeled as such, may be used.

PART 2 - PRODUCTS

2.01 STRUCTURAL FILL

- A. Structural fill shall be imported well graded granular material free of organics and debris. Maximum particle size 4 inches and no more than 5 percent fines (material passing No. 200 sieve).

2.02 NONSTRUCTURAL FILL

- A. Nonstructural fill shall be on-site or imported well-graded granular material free of organics and debris. Maximum particle size 4 inches and no more than 30 percent fines (material passing No. 200 sieve). Material shall be capable of being compacted as specified under the weather conditions prevailing at time of construction.

2.03 TOPSOIL

- A. Topsoil shall be on-site or imported material that conform with Section 8-02.3(4) of the WSDOT Standard Specifications.

2.04 GRAVEL BACKFILL FOR PIPE ZONE BEDDING

- A. Gravel backfill for pipe zone bedding shall conform with Section 9-03.12(3) of the WSDOT Standard Specifications.

2.05 SAND

- A. Sand shall conform with Section 9-03.13 of the WSDOT Standard Specifications.

2.06 GRAVEL BACKFILL FOR WALLS

- A. Gravel backfill for walls shall conform to Section 9-03.12(2) of the WSDOT Standard Specifications.

2.07 GRAVEL BACKFILL FOR DRAINS

- A. Gravel backfill for drains shall conform to Section 9-03.12(4) of the WSDOT Standard Specifications.

2.08 GRAVEL BEDDING FOR SEPTIC

- A. Gravel backfill for septic shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100
5/8-inch	50-100
No. 4	20-80
No. 40	3-24
No. 200	10 max.
Sand Equivalent	35 min.

2.09 QUARRY SPALLS

- A. Quarry spalls shall be crushed quarry rock. Spalls shall be hard, sound and unweathered. Quarry spalls shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
6-inch	100
3-inch	40 max.
3/4-inch	10 max.

2.10 CONTROLLED DENSITY FILL (CDF)

- A. CDF shall conform to section 2-09.3(1)E of the WSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner's Representative. Unauthorized excavation, as well as remedial work directed by the Owner's Representative, shall be at no change in contract amount.
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with CDF or lean mix concrete. The bottom width of the excavation shall be defined by a line extending downward and out from the outer edge of the footing at an angle of 1H:1V.
 2. Elsewhere, backfill and compact unauthorized excavations with structural fill as specified herein.
- B. Overexcavation: In certain areas where soft spots occur in the subgrade, satisfactory sub-grade shall be achieved by overexcavation and replacement with structural fill material or lean mix concrete.
1. Location and extent of soft spot areas to be verified by Owner's Geotechnical Consultant in the field.
- C. Stability of Excavations: Slope the sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- D. Shoring and Bracing: Provide shoring and bracing to comply with local codes and authorities having jurisdiction. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.
- E. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and

-
- other dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure to convey water. Do not use trench excavations as temporary drainage ditches.
- F. Material Storage: Stockpile excavated materials as required. Place, grade, shape and cover stockpiles for proper drainage and to prevent accumulation of excess moisture.
1. Locate and retain soil materials away from edge of excavations.
 2. Dispose of excess soil material and waste materials legally off-site.
- G. Excavation for Buildings and Retaining Walls
1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10-foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and inspection.
 2. In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete. Compact base to the density required and allow testing of compaction prior to constructing concrete forms.
 3. Place footings on native soils, or properly compacted fill material. Where existing soft materials are encountered below footings, overexcavate as required by the Owner's Geotechnical Consultant or until dense native soil is encountered and backfill with lean concrete. The minimum lateral limits of the overexcavation and lean concrete backfill beneath footings shall be defined by a line extending downward and out from the outer edge of the footing at an angle of 1H:1V. Maintain side slopes as required by authorities having jurisdiction.
- H. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown within a tolerance of plus or minus 0.10-foot.
- I. Excavation for Planting Areas: Conform to cross-sections, elevations and dimensions shown, within a tolerance of plus or minus 0.10-foot.
- J. Excavation for Trenches
1. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations.
 2. Where rock is encountered, carry the excavation 6 inches below the required elevation and backfill with a 6-inch layer of structural fill.
 3. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for the entire body of the pipe.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.02 SUBGRADE VERIFICATION

- A. Following site preparation and excavation for the building, paved surfaces and roadways, the exposed subgrades shall be observed and approved by the Owner's Geotechnical Consultant.
- B. Overexcavate any soft, loose or disturbed soils identified by the Geotechnical Consultant and replace with compacted structural fill.
- C. If required by Geotechnical Consultant, provide equipment and labor for proof rolling.

3.03 BACKFILL AND FILL

- A. For backfill of all excavations use material sampled and tested by the Owner's Geotechnical Consultant.
- B. All fill used for the following shall be structural fill:
 - 1. Fill beneath footings and foundations.
 - 2. Backfill against footings, foundations and structural walls, except 18 inches of gravel backfill for walls shall be placed immediately adjacent to structures for drainage, unless otherwise shown on the drawings.
 - 3. Fill beneath building slabs.
 - 4. Fill within 3 feet vertically of the base of pavements
- C. Fill beneath areas to be landscaped shall be nonstructural fill.
- D. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Acceptance by Owner's Representative of construction below finish grade including, where applicable, waterproofing, dampproofing, piping, conduits and perimeter insulation.
 - 2. Inspection, testing, approval and recording locations of underground piping and conduits. Coordinate locations with surveyor for as-built survey.
 - 3. Removal of concrete formwork.
 - 4. Removal of shoring and bracing and backfilling of voids with satisfactory materials.
 - 5. Removal of trash and debris.
 - 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- E. Ground Surface Preparation
 - 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills. On existing sloped surfaces, steeper than 1 vertical to 4 horizontal, cut benches into hillsides of 10 feet minimum width and 5 feet maximum height.
 - 2. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to within 2 percent of the optimum

moisture content, and compact to required depth and percentage of maximum density.

- F. Placement and Compaction: Allowable thickness of fill lifts will depend on the material type and compaction equipment used. In no case place backfill and fill materials in layers more than 8 inches in loose depth for material compacted by heavy compaction equipment, and more than 4 inches in loose depth for material compacted by hand-operated tampers. For fill deeper than 3 feet below the base of pavements, lifts may be 12 inches maximum in loose depth.
1. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content.
 2. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.
 3. Do not place backfill or fill material on surfaces muddy, frozen, or containing frost or ice.
 4. Place backfill and fill materials in such a manner as to prevent wedging action of backfill against structures.

3.04 COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D 1557 ("Modified Proctor"):
1. Structures: Compact top 12 inches of subgrade where exposed, and each layer of backfill or fill material to 95 percent of maximum dry density.
 2. Building Slabs and Steps: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
 3. Lawn or Unpaved Areas: Compact top 12 inches of subgrade and each layer of backfill or fill material to 85 percent of maximum dry density.
 4. Walkways: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
 5. Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
 6. Utility Bedding and Backfill: Compact each layer of bedding and backfill to 95 percent of maximum dry density.
 7. Granular Fill Placed Against Subgrade Walls: Compact to 90 percent of maximum with small hand-operated equipment to avoid overcompaction.
- C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Prevent free water from appearing on surface during or subsequent to compaction operations.
1. Remove and replace, or scarify and air dry, soil material too wet to permit compaction to specified density.
 2. Soil material removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.05 GRADING

- A. General: Uniformly grade areas of work including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces shall be free from irregular surface changes.
- C. Compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact surfaces to the depth and percentage of maximum density for each area classification.

3.06 WET WEATHER PROVISIONS

- A. Schedule earthwork operations to minimize the potential for erosion, siltation, and disturbance of site soils.
- B. Perform earthwork operations in discrete areas as required to minimize the exposure of disturbed soils to wet weather.
- C. Compact exposed soil to reduce the infiltration of rain water.
- D. Direct surface water away from fills and excavations.
- E. Provide temporary pumping equipment to keep excavations and construction free of water.
- F. Soils that become too wet for compaction shall be removed and replaced with compacted structural fill.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Transport acceptable excess excavated material to temporary stockpile areas on the Owner's property. Remove any unused excess excavated material from the site, and dispose of legally off the Owners property, prior to final inspection.
- B. Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of legally off the Owner's property.

3.08 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow Owner's Geotechnical Consultant to observe, test and approve subgrades and fill layers before further construction work is performed.

- B. Footings for structures and retaining walls shall be observed by the Geotechnical Consultant for bearing capacity verification prior to concrete placement. Compaction tests shall be performed if in the opinion of the Geotechnical Consultant they are necessary.
- C. If subgrades or fills which have been placed are below specified density, provide corrective work as specified at no additional expense.

3.09 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work as specified, with retesting, prior to further construction.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work includes clearing and grubbing areas within the boundary limits shown on the plans or staked by the Engineer. This work also includes protecting from harm all trees, bushes, shrubs or other objects selected to remain.
 - 1. "Clearing" means removing and disposing of all unwanted material from the surface such as trees, brush, down timber or other natural materials.
 - 2. "Grubbing" means removing and disposing of all unwanted vegetative matter from underground such as sod, stumps, roots, buried logs or other debris.
 - 3. "Debris" means all nonusable natural material produced by clearing and grubbing.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic routes if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 DISPOSAL

- A. Disposal shall be in conformance with Section 2-01.2 of the WSDOT Standard Specifications and local jurisdiction requirements except that on-site burning shall not be allowed.

3.02 CLEARING

- A. Clearing shall be in conformance with Section 2-01.3(1) of the WSDOT Standard Specification.

3.03 GRUBBING

- A. Grubbing shall be in conformance with Section 2-01.3(2) of the WSDOT Standard Specification.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing, placing, and compacting aggregate for aggregate base course as indicated.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions or the dated references (as noted) of the following documents.
 - 1. Washington State Department of Transportation (WSDOT)
 - a. WSDOT Standard Specifications for Road, Bridge and Municipal Construction latest version
 - b. WSDOT Standard Plans
 - 2. ASTM International (ASTM)
 - a. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - b. ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS AND TRANSMITTALS

- A. Submit the following:
 - 1. Material source, and all tests and certifications necessary to determine compliance with the specifications in this Section.
- B. Transmit the following:
 - 1. Test Reports: Provide plant and field test reports as specified in Articles 2.02 and 3.04 herein.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Aggregate: Comply with WSDOT Standard Specifications Section 9-03.

2.02 SOURCE QUALITY CONTROL

- A. Perform sampling and tests of the aggregate base material in accordance with WSDOT Standard Specifications Section 9-03.20.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Subgrade Examination
 - 1. Call for an inspection by the Owner and obtain written acceptance of the prepared subgrade before proceeding with the placement of aggregate base course.

3.02 PREPARATION

- A. Perform subgrade preparation in accordance with the lines, finished grades, pavement sections, and typical cross sections indicated on the Contract Drawings.
- B. Subgrade preparation: Refer to Earthwork as stated elsewhere in the Contract Documents.

3.03 CONSTRUCTION

- A. Place and compact aggregate base courses in accordance with the lines, finished grades, pavement sections and typical cross sections indicated on the Contract Drawings.
- B. Construction requirements: Comply with WSDOT Standard Specifications Section 4-04.3.

3.04 FIELD QUALITY CONTROL

- A. Test for compliance with specified requirements for density and compaction of aggregate base as specified in WSDOT Standard Specifications Section 4-04.3(5).
- B. Moisture content shall not vary more than 3 percent above or below the optimum moisture content as determined by test method ASTM D1557.
- C. Independently test each material type and/or when a material source changes.
- D. Tolerances: Maximum allowable deviation in measured thickness of Aggregate Base Course surfacing is 1/2 inch less than specified depth.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for providing and placing Hot Mix Asphalt (HMA) on a prepared base in accordance with lines, grades, pavement section thickness, and typical cross-sections shown on the Contract Drawings.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections, and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Mix Design: Comply with WSDOT Standard Specifications Section 5-04.2.
- B. Transmit the following:
 - 1. Test Reports: Provide test results of sampling and testing, inspection records within 24 hours of asphalt concrete placement.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. AGGREGATES FOR HOT MIX ASPHALT
 - 1. Aggregates for HMA pavement shall comply with WSDOT Standard Specifications Section 9-03.8.
- B. TACK COAT
 - 1. Tack coat shall be ASTM D977 emulsified asphalt or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted with water at a rate not to exceed

one part water to one part emulsified asphalt, of suitable grade and consistency for application.

2.02 MIXES

- A. Mix design for HMA shall comply with WSDOT Standard Specification Section 5-04.2.
- B. The nominal maximum aggregate size class is as indicated on the Contract Drawings.
- C. Asphalt binder: PG 58H-22. The Contractor may propose the substitution of alternate grades of performance grade (PG) asphalt binder, for Owner review and considerations, at no cost to Owner. Asphalt binder shall comply with WSDOT Standard Specifications Section 5-04.2.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare subgrade for surfacing as stated elsewhere in the Contract Documents.
- B. Construct aggregate base course surfacing as stated elsewhere in the Contract Documents.

3.02 TACK COAT

- A. Tack coat shall be placed to all paved surfaces on which any course of HMA is to be placed or abutted in conformance with Section 5-04.3(4) of the WSDOT Standard Specifications

3.03 CONSTRUCTION

- A. HMA pavement shall be constructed in conformance with Section 5-04 of the WSDOT Standard Specifications, except as modified herein. Prime coat is not required and tack coat is required as specified therein.
- B. HMA pavement more than three inches thick shall be placed in multiple layers. Each layer shall not exceed three inches in thickness or be less than two inches. Asphalt concrete pavement three inches thick or less may be placed in one layer.

3.04 MAINTENANCE OF PAVEMENT

- A. Maintain finished pavement in finished clean condition until the work is accepted by the Owner.

END OF SECTION

SECTION 32 13 13

CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for providing Portland Cement Concrete pavement for roadways, driveways, sidewalks and plaza, curbs, and curb ramps.

1.02 STANDARD SPECIFICATIONS

- A. All Work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS AND TRANSMITTALS

- A. Submit the following:
 - 1. Concrete Mix Designs: Comply with WSDOT Standard Specifications Section 5-05.
 - 2. Shop Drawings:
 - a. Provide drawings showing the locations of all joints in concrete, including construction joints, expansion joints, isolation joints, and contraction joints.
 - b. Provide drawings indicating concrete placement method, sequence, location, and boundaries. Include each type and class of concrete and quantity in cubic yards.
- B. Transmit the following:
 - 1. Product Data: Provide manufacturers' product data for proposed concrete admixtures.
 - 2. Detectable warning surface for curb ramps. Transmit manufacturer's cut sheets for detectable warning surfaces.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials in construction of cement concrete pavements, including but not limited to Portland cement, aggregates, reinforcing steel, curing materials and admixtures as shall comply with WSDOT Standard Specifications Section 5-05.2
- B. High-early strength Portland cement concrete mixes may be used with the approval of the Owner.
- C. Detectable warning surface shall comply with WSDOT Standard Specifications Section 8-14.2.

2.02 MIXES

- A. Concrete design mixtures shall conform to Section 5-05.3(1) of the WSDOT Standard Specifications. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Where class of concrete is not indicated on the Contract Documents, mix design shall comply with the following:
 - 1. Concrete mix for Portland cement concrete pavement for arterial and non-arterial roadways, transit drive, and driveway approach entrances shall comply with WSDOT Standard Specifications Section 5-05.3(1).
 - 2. Concrete mix for Portland cement concrete for non-roadways shall comply with WSDOT Standard Specifications Sections 8-14 and 6-02. Portland cement concrete sidewalk and curb ramps shall be Class 3000.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare subgrade for surfacing as stated elsewhere in the Contract Documents.
- B. Construct Aggregate Base Course surfacing as stated elsewhere in the Contract Documents.
- C. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Owner in writing of conditions detrimental to the proper and timely completion of the work.
- D. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.02 CONSTRUCTION

- A. Construct Portland cement concrete pavement in accordance with the lines, grades, pavement section thicknesses, and typical cross-sections indicated on the Contract Drawings. Remove and replace pavement that is not within the allowable tolerances for line, grade, thickness and cross-section.
- B. Construct Portland cement concrete pavements for roadways in conformance with WSDOT Standard Specifications Section 5-05.3.
- C. Construct Portland cement sidewalks and curb ramps in conformance with WSDOT Standard Specifications Section 8-14.3.
- D. Detectable warning surfaces in conformance with WSDOT Standard Specifications Section 8-14.3(5).

3.03 FIELD QUALITY CONTROL

- A. Pavement opening to traffic shall be in accordance with WSDOT Standard Specifications Section 5-05.3(17)
- B. Do not open newly constructed pavements to traffic until the Owner has given approval.
- C. Paving Tolerances:
 - 1. Comply with dimensions as shown on the plans with tolerances as follows:
 - a. Elevation: 1/4 inch
 - b. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - c. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
 - d. Joint Spacing: 3 inches.
 - e. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - f. Joint Width: Plus 1/8 inch, no minus.

END OF SECTION

SECTION 32 16 13

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for constructing cement concrete curbs and gutters.

1.02 REFERENCES

- A. This Section incorporates by reference the latest revisions or the dated references (as noted) of the following documents.
 - 1. ASTM International (ASTM)
 - a. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - b. ASTM C143/C143M Standard Test Method for Slump of Hydraulic-Cement Concrete
 - c. ASTM C150/C150M Standard Specification for Portland Cement
 - d. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 2. Washington State Department of Transportation (WSDOT)
 - a. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction latest version
 - b. WSDOT Standard Plans

1.03 SUBMITTALS AND TRANSMITTALS

- A. Submit the following:
 - 1. Concrete Mix Design: Provide concrete mix design and test results.
- B. Transmit the following:
 - 1. Product Data: Provide manufacturers' product data for all materials being used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete for Extruded Concrete Curb:
 - 1. Minimum 28-day compressive strength of 3,000 pounds per square inch.
 - 2. Slump (ASTM C143/C143M) not to exceed 1 inch.
 - 3. Maximum coarse aggregate 3/4 inch.
 - 4. Air-entrainment 5 percent plus or minus 1-1/2 percent.

- B. Concrete for Cast-in-Place Curbs: In accordance with WSDOT Standard Specifications Section 6-02.
- C. Dowels and reinforcing steel: Shall be No 3 deformed steel billet bars, ASTM A615/A615M, Grade 60.
- D. Portland cement: Conform to the requirements of ASTM C150/C150M.
- E. Pre-molded Joint Filler: In accordance with WSDOT Standard Specifications Section 9-04.1.
- F. Bonding Material: Epoxy Bonding Agent shall be in accordance with ASTM C881/C881M for Type II epoxy resin.
- G. Curing Compound: In accordance with WSDOT Standard Specifications Section 9-23.2.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General
 - 1. Construct curbing in accordance with the layout, configurations, grades, and dimensions indicated on the Contract Drawings.
 - 2. Construct all curbs in accordance with WSDOT Standard Specifications Section 8-04.
- B. Extruded Cement Concrete Curbs
 - 1. Place, shape and compact extruded cement concrete curb true to line and grade with an extrusion machine capable of shaping and thoroughly compacting the concrete to the required cross section.
 - 2. Dry and clean pavement of loose or deleterious materials prior to curb placement. Anchor concrete curbs to the existing pavement using epoxy bonding agent. Place according to the recommendations of the bonding agent manufacturer.
 - 3. Load the hopper of the curb machine with the homogenous mix. Run each hopper load of cement concrete through the curb laying machine, adjust it properly to form and compact the cement concrete mix for the curb.
 - 4. Space joints in the extruded cement concrete curb at 10-foot intervals or to match existing transverse joints or cracks in existing pavement. Cut joints vertically.
 - 5. Curing compound shall be Type 2 liquid curing compound.
 - 6. Protect newly placed extruded cement concrete curb from traffic by barricades or other suitable means until it has attained its required strength of 2500 pounds per square inch. Leave protection measures in place for at least 72 hours.
- C. Cast-in-Place Curbs and Gutters:
 - 1. Construction shall be in accordance with WSDOT Standards Specifications Section 8-04.

3.02 FIELD QUALITY CONTROL

- A. Ensure that when checked with a 10-foot straightedge, grade does not deviate more than 1/8-inch, and alignment does not vary more than 1/4 inch.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS AND SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes:
 - 1. Pavement markings
 - 2. Traffic control signage.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

PART 2 - PRODUCTS

2.01 PAINT

- A. Paint for pavement markings shall comply with Section 9-34.2 of the WSDOT Standard Specifications. The paint shall be factory mixed, quick drying and nonbleeding. Colors shall be as indicated on the drawings.

2.02 GLASS BEADS

- A. Glass beads for pavement markings shall comply with Section 9-34.4 of the WSDOT Standard Specifications

2.03 PLASTIC

- A. Plastic for pavement markings shall comply with Section 9-34.3 of the WSDOT Standard Specifications.
- B. Colors shall be as indicated on the drawings.

2.04 SIGNS

- A. Traffic control signs shall be reflective sheeting on sheet aluminum conforming to Sections 9-28.8 and 9-28.12 of the WSDOT Standard Specifications. Posts shall conform to Section 9-28.14 of the WSDOT Standard Specifications.

PART 3 - EXECUTION

- 3.01 Pavement markings installation shall conform with Section 8-22.3 of the WSDOT Standard Specifications, except that the Contractor shall be responsible for all layout and control points, striping shall not deviate more than 1/4-inch in 10 feet from a straight line and striping shall not be more than 1-inch from the specified locations. Paint striping shall only be applied after the pavement has been allowed to cure 14 days minimum, when the pavement is clean and dry and when the temperature is above 50 degrees F.
- 3.02 Signs shall be located and installed as shown on the plans. All sign posts shall be plumb and all signs shall be level.

END OF SECTION

SECTION 32 91 00

PLANTING PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes administrative and procedural requirements for providing and installing planting soils, including but not limited to the following:
 - 1. Supplementing of soil material if necessary
 - 2. Testing and analysis of soils as indicated for conformance to the specification
 - 3. Testing of supplemented soil material for conformance

1.02 STANDARD SPECIFICATIONS

- A. All Work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 REFERENCES

- A. ASTM
 - 1. D422 Standard Test Method for Particle-Size Analysis
 - 2. D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - 3. D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
 - 4. D2167 Standard Test Method for density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - 5. D5856-15 Standard Test Method for Measurement of Hydraulic Conductivity of Porous Material Using a Rigid-Wall, Compaction-Mold Permeameter
 - 6. D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

- B. US EPA Class A standard, 40CFR § 503.13, Tables 1 and 3 levels Chemical Contaminants mg/kg (ppm)
- C. NAPT: The North American Proficiency Testing Program
- D. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- E. SSSA: Soil Science Society of America.

1.04 SUBMITTALS AND TRANSMITTALS

- A. Submit the following
 - 1. Submit on-site soil and supplementary off-site soil, if needed, for testing at least 12 weeks before scheduled installation of soil materials.
 - 2. Do not order or deliver any soils, components or amendments until submittals have been returned "No Exceptions Taken". Said action by the Owner's Representative does not constitute final acceptance. The Owner's Representative reserves the right to reject any material delivered to the site, stockpiled for use on the site, or moved and spread anywhere on the site, that does not meet the requirements of this Specification.
 - 3. Recognize these submittals are time-critical. Do not delay in organizing and making the submittals as specified. The testing protocols and iterative resubmissions shall be considered long lead-time items. Failure to make submittals on a timely basis shall constitute failure to meet project requirements.
 - 4. Testing shall be at the Contractor's expense. Deliver all samples to the Testing Laboratories and to the Owner's Representative by overnight delivery and assume all costs.
 - 5. Testing reports shall be sent directly to the Owner's Representative.
- B. Perform soil tests and provide test reports for on-site and off-site soils meeting the following requirements:
- C. Comprehensive Particle Size Analysis:
 - 1. On-site soil and off-site soil: Determine soil texture in accordance with USDA Textural Classification System by combined Hydrometer Analysis for silt and clay, and dry sieving of sands. Standard Sieve sizes shall be used: No. 10, 18, 35, 60, 140 and 270 (2.00 mm, 1.00 mm, 0.50 mm, 0.25 mm, 0.10 mm, 0.05 mm). For particle sizes less than No. 270 (0.05 mm), testing in accordance with ASTM D422, Hydrometer method.
 - a. Soil Ph (Soil acidity): Ph by SMP method in accordance with Northeastern Regional Publication No. 493, 3rd Edition, Chapter 3.
 - b. Cation Exchange Capacity (CEC): by Compulsive Exchange
 - c. Soluble Salts: Extract Method for air-dried samples of 1-part Soil to 2-parts Water (1:2 volume to volume), in accordance with the requirements of Northeastern Regional Publication No. 493, 3rd Edition, Chapter 10. Submit as mmhos/cm (Ds/m)

2. Organic content: Loss of Weight on Ignition Chemical analysis for extractable phosphorus, potassium, total nitrogen, inorganic nitrogen, calcium, magnesium, sulfur, boron, aluminum, iron, manganese, zinc, lead, copper and molybdenum.

1.05 ACTION SUBMITTALS – SAMPLES

- A. Samples: Samples and testing shall be undertaken to ensure that any supplemental soils required from off site shall match existing on-site soils. For on-site soil and off-site soil, submit to the Owner's Representative a one gallon volume in sealed containers labeled with the content, source and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.
 1. Provide a one gallon sample from each source with required soil testing results. The sample shall be a mixture of the random samples taken around the source stockpile or field.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency, demonstrate in writing that the testing agency is NAPT-affiliated and can perform the specified tests in accordance with the specified testing procedures.

1.07 QUALITY ASSURANCE – TESTING AGENCY

- A. Testing Agency Qualifications: Agricultural soil testing laboratory, NAPT – participating, independent, State-operated or university-operating laboratory experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
- B. Soil Test Agency shall utilize the following soil test procedures and methods for the Western Region: Soil, Plant and Water Reference Methods for the Western Region, 2005, 3rd Edition. Agricultural Experiment Stations of Washington, Oregon, Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, New Mexico, Nevada, Utah, and Wyoming
- C. Perform percolation testing of the prepared subgrade every 10,000 square feet. After subgrade levels have been reached, the Contractor and the Owner's Representative will inspect soil conditions together to evaluate subsurface drainage conditions. Locations where percolation rates are less than 1.0 inch per hour shall be deep de-compacted, recompressed and re-tested. If the subgrade fails to drain adequately after re-work, installation of drain lines or other mitigation measures may be required.

1.08 SOIL-SAMPLING REQUIREMENTS

- A. Sampling shall be done by the Contractor. The size of the samples and method of sampling shall be as follows: Samples shall be representative of the material to

be brought to the site. Each sample shall be a Composite Sample, which consists of 8 separate sub samples taken from a minimum of eight different locations at each source and mixed together to make the test sample.

1. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
2. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.09 DELIVERY, STORAGE, AND HANDLING OF STOCKPILED SOIL

- A. Protect stockpiled on-site and off-site soils:
1. Protect from theft, damage, weather, dirt, oils, grease, and construction activities.
 2. Prohibit vehicular and pedestrian traffic on or around stockpiled soil.
 3. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 4. Do not move or handle soil when it is wet or frozen.
 5. Stockpile in windrows less than six feet high.
- Cover during precipitation events to minimize saturated soil conditions. Do not manipulate when in a wet or frozen condition, to include planting operations.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. The soil excavated during site preparation shall be stockpiled on site for reuse. It shall be properly windrowed and left in place until the time of spreading.
- B. The Owner does not stipulate that there will be sufficient on-site soil to meet the specified requirements, needs, soil depths or soil volumes specified in these Specification Sections. Off-site soil shall be brought to the site to supplement the stockpiled on-site soil as needed. Off-site soil shall be harvested from within the shrub-steppe biome; it shall be unamended native soil representative of the soils in the biome.
- C. Test on-site stockpiled soil to determine Soil Texture, Soil pH, CEC, Soluble Salts, Organic Content. If additional soil is needed, test all off-site soil to ensure that the imported soil matches the on-site soil.
- D. Soil shall not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants and noxious weeds. Off-site soil shall not be delivered or used for planting while in a frozen or muddy condition.
- E. All soils shall be free of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

PART 3 - EXECUTION

3.01 TRANSPORT AND DELIVERY OF SOILS

- A. The Contractor shall provide sufficient soil to complete the work of the Contract.
- B. Locate, procure and delivery soils sufficiently in advance of earthwork and earth moving activities, landscape grading, planting and turf establishment to meet Project schedules.
- C. Deliver soils and soil components to the Project site in tarpaulin-covered trucks. Stockpile in locations approved by the Owner's Representative.
- D. Stockpiled soil shall be protected from erosion and sedimentation.

3.02 INSTALLATION

- A. Install existing on-site stockpiled soil and off-site soil planting soil to meet proposed grades for areas of site improvements or to restore existing grades in disturbed areas.
- B. Grade areas to be seeded to a smooth, free draining even condition. Roll, scarify, rake, and level as necessary to obtain true, even surfaces and fill depressions as required to drain.
- C. Do not move heavy objects except necessary lawn making equipment over the areas to be seeded after the soil surface is prepared.

3.03 CLEANUP

- A. No debris may be left on the site. Excavated material shall be removed as directed.

END OF SECTION

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work of this Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary for preparation, seeding, fertilizing, mulching, and protection of hydroseed areas of lawn.

1.02 STANDARD SPECIFICATIONS

- A. All Work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS

- A. Product Data: Provide Manufacturer's product data for:
 - 1. Hydromulch
 - 2. Soil Binding Agent
- B. Certifications
 - 1. Submit seed vendor's certification for required seed mixture, indicating percentage by weight and percentages of purity, germination and weed seed for each grass species.

1.04 QUALITY ASSURANCE – LANDSCAPE CONTRACTOR

- A. Landscape Contractor: A single firm licensed in the state of Washington with at least five (5) years of experience on projects of similar scope and experienced in landscape work of the highest professional quality. Provide qualified personnel experienced in all phases of the seeding and fertilizing operation, equipment and methods as herein specified.

1.05 DELIVERY, STORAGE, AND HANDLING OF SEED

A. Requirements

1. Delivery: deliver seed to the site in original, unopened bags bearing seed producer's name, Genus-species-variety and common names of the seed, indication of conformance to the requirements of this Section.
2. Protection: Protect seed from becoming wet, from drying out and from contamination during delivery, on-site storage, and handling.
3. Storage: Store seed in cool, dry locations away from contaminants.

1.06 PROJECT CONDITIONS

- A. Inspect areas to be prepared and seeded before starting work and any defects such as overly compacted soils or surface drainage problems and make written report of such to the Owner's Representative prior to beginning this work. The commencement of work shall indicate Landscape Contractor's acceptance of the areas to be improved, and assumption of full responsibility for the work of this Section.
- B. The Contractor shall be solely responsible for judging the full extent of work requirements involved.

PART 2 - MATERIALS

2.01 PLANTING SOIL

- A. Planting soil specified and installed under Section 32 91 00 PLANTING PREPARATION.

2.02 SEED – GENERAL

- A. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall the weed seed content exceed 0.25% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed and properly labeled containers.
- B. All seed shall comply with State and Federal seed laws and shall carry 'Certified State of Origin' tags on their bags or containers at the time of seeding. Seed shall conform to applicable state seed laws and standards of minimum purity, minimum germination, maximum crop seed, maximum weed seed, and be free of noxious weed seed as specified in this Section.
- C. Seed that has become wet, moldy or otherwise damaged shall not be acceptable.

2.03 SEED MIX

- A. Seed mix in accordance with WSDOT Standard Specifications 9-14.2.

2.04 TACKIFIER

- A. Tackifier shall be as recommended by the seed supplier and approved by the owner's Representative. It shall be suitable for slurry application; non-toxic and free of plant-growth or germination inhibitors.

PART 3 - EXECUTION

3.01 FILLING AND COMPACTION

- A. Install existing on-site stockpiled soil and supplementary off-site soil planting soil as needed to meet proposed grades for areas of site improvements or to restore existing grades in disturbed areas.
- B. Immediately before seeding, planting soil shall be restored to an even condition.

3.02 SEED ESTABLISHMENT – GENERAL

- A. It is an essential aspect of this Contract to establish a full and healthy grass landscape meeting the needs of the Owner, in accordance with the requirements of this Specification and as directed by the Owner's Representative.
- B. Contractor shall obtain Owner's Representative's written approval of fine grading work before doing any seeding.
- C. All areas disturbed by the Contractor that is the result of negligence of the Contractor or any of his assigned workers or sub-contractors outside the limit of seeding shall be prepared and seeded as specified herein and as directed by the Owner at no additional cost.
- D. Apply seed in a manner that provides direct seed to soil contact. Seed application system employed by the Contractor that does not apply seed directly to the surface of the soil or cultivates the seed into the soil shall be rejected. If seeding is accomplished by hydroseeding, mulch shall be applied in a second application following seeding.
- E. The seed bed shall not be watered following seeding and mulching. Rainfall shall be the sole source of water for seeded areas.

3.03 PREPARE SEED BED

- A. Grade areas to be seeded to a smooth, free draining even condition. Roll, scarify, rake, and level as necessary to obtain true, even surfaces and fill depressions as required to drain.
- B. Do not move heavy objects except necessary lawn making equipment over the areas to be seeded after the soil surface is prepared.

3.04 SEEDING

- A. The season for seeding shall be from April 1 to June 15 or from September 1 to October 1. The actual planting of seed shall be done, however, only during periods within this specified season that are normal for such work as determined by weather conditions, by accepted practice in this locality and as approved by the Owner.
- B. Means and methods of seeding shall be determined by the Contractor based on his/her experience, site conditions, season of seeding, weather conditions and any, all or other environmental conditions. Seeding may be by broadcast seeding or hydroseeding.
 - 1. If hydroseeding is selected, seed and tackifier shall comprise the first application. The approved mulch shall be applied in the second application. The mulch shall not be incorporated into the initial application.
 - 2. If broadcast seeding is employed for Seed Mix, following seeding, apply a 2-3" layer of dry straw on top of the seed and crimp the straw into the seed bed.
- C. The seed bed shall not be watered following seeding and mulching. Rainfall shall be the sole source of water for seeded areas.

3.05 ACCEPTANCE STANDARDS FOR SUBSTANTIAL COMPLETION OF SEEDING

- A. When in the Contractor's opinion and standards of acceptance have been achieved, notify the Owner's Representative in writing for a formal punch list inspection. Request for inspection shall be received by the Owner at least 10 Days before anticipated date of inspection.
- B. The Owner's Representative will inspect the seeded areas and judge the quality of seeding and mulching. With three days of this punch list inspection the Owner's Representative will issue an inspection report. If there are items that require additional work a Punch List will be issued and the Contractor shall fulfill the requirements of the Punch List prior to requesting a second inspection for Substantial Completion. If, during the first Punch List inspection, the Owner's Representative determines the fields meet the Acceptance Requirements then Substantial Completion may be granted by formal written approval.
- C. Following the spring growing season, the Owner's Representative shall inspect the seeded areas and assess the grass establishment. The Owner's Representative will be the sole judge of seeding acceptance. If the Owner's Representative finds the seeded areas do not meet the acceptance standards then a deficiency report will be issued with specific Punch List items identified.
 - 1. Seeded areas to be corrected shall be prepared and reseeded in accordance with the requirements of this Section.

3.06 FINAL ACCEPTANCE

- A. Review to determine Final Acceptance of seeded areas will be made by the Owner's Representative upon request by the Contractor. Provide notification of at least five working days before requested review date.

3.07 RESTORATION AND CLEAN-UP

- A. Absolutely no debris may be left on the site. Excavated material shall be removed as directed. Repair any damage to site or structures to restore them to their original condition, as directed by the Owner, at no cost to the Owner.

END OF SECTION

SECTION 33 11 00

WATER DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes requirements for providing water service supply mains, modifications to existing water mains, new water services, fire service mains and their appurtenances and creation of legal description for easement required by Washington Water Service.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections, and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS AND TRANSMITTALS

- A. Transmit Product Data: Include data on pipe, fittings, and appurtenances including manufacturer's recommendations for pipe installation.
- B. Submit Lay plans for the pipeline construction. Include details for each connection to an existing main and services to be maintained or installed, including temporary water services and hydrants. The review of this submittal by the Owner and local water purveyor does not relieve the Contractor of responsibility to any damage to existing utilities due to his operation.
- C. Submit Work Plan for all work identified under this Section. Provide separate work plans for each utility owner. Include the restrained joint manufacturer's recommendations for pipe installation as an attachment to the Work Plan.

1.04 QUALITY ASSURANCE

- A. Comply with Island County regulatory requirements for water service mains and piping, appurtenances, and testing.

1.05 CONNECTION TO EXISTING WATER MAINS WORK PLAN

- A. Contractor work sequence and means and methods for connection to existing water mains and temporary provisions required to maintain service shall be identified in the work plan. The work plan is subject to approval of both the Resident Engineer and Island County. The work plan shall include a description of the scope of work, a schedule for subtasks, a schedule for shutdowns (if required), calculations documenting adequacy of support and thrust restraint. The work plan will also identify if there is work by the utility owner and the plan for notification to affected parties.
- B. Transmit Record Documents: Show actual locations of water main and appurtenances with as-built documentation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Inspection: Inspect pipe before it is installed. Remove defective products from the Project Site.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Install only new materials for water distribution. Verify all direct and indirect water system components which come into contact with potable water have National Sanitation Foundation certification.

2.02 PIPE AND FITTINGS

- A. Pipe and fittings shall conform to the WSDOT Standard Specifications Section 7-09.2 for water mains.

2.03 VALVES

- A. Valves shall be gate valves conforming to Section 7-12.2 of the WSDOT Standard Specifications. Valve boxes shall be installed on all valves.

2.04 FIRE HYDRANTS

- A. Fire hydrants shall conform to Section 7-14.2 of the WSDOT Standard Specifications.

2.05 DETECTABLE MARKING TAPE

- A. Detectable marking tape shall conform to 9-15.18 of the WSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate the installation of the water main distribution system with local water purveyor and other utilities to avoid conflicts.

3.02 PROTECTION

- A. Prevent water from entering trenches and excavations.
- B. Other than chlorination chemicals and water, place nothing inside pipes and fittings.
- C. Protect exposed, installed pipe from damage and flooding.
- D. Keep installed pipe clean until work has been accepted.
- E. Protect pipe coatings from damage during storage and installation.

3.03 TRENCHES

- A. Trenches shall be excavated and backfilled, and the pipe shall be bedded in conformance with Section 7-09.3 of the WSDOT Standard Specifications.

3.04 TRENCH SAFETY AND SUPPORT SYSTEMS

- A. Where trench excavation is deeper than 4 feet, construct and maintain safety systems that meet the requirements of the Washington Administrative Code (WAC) Chapter 296-155 Part N. Comply with excavation support and protection requirements as stated elsewhere in the Contract Documents.

3.05 PIPES AND VALVES

- A. Pipes and valves shall be installed in conformance with Section 7-09.3 and 7-12.3 of the WSDOT Standard Specifications.
- B. Minimum depth of cover over the pipe is 36 inches.
- C. Water main shall not be placed in service until after all tests, flushing, and disinfection have been successfully completed and the installed water main and appurtenances have been approved by the Owner and local water purveyor.

3.06 SERVICE CONNECTIONS

- A. Service connections shall be installed in conformance with Section 7-15.3 of the WSDOT Standard Specifications.

3.07 DETECTABLE MARKING TAPE

- A. Detectable marking tape shall be installed on all new waterlines in accordance with Section 7-09.3(20) of the WSDOT Standard Specifications.

3.08 TESTING

- A. Water system shall pressure-tested in conformance with Section 7-09.3(23) of the WSDOT Standard Specifications.

END OF SECTION

SECTION 33 30 00

SANITARY SEWERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work includes requirements for providing the sanitary sewerage system and connection to the existing sanitary sewer system, temporary bypasses, building sewer installation and connections, demolition, and utility support system.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS AND TRANSMITTAL

- A. Product Data: Transmit catalog cuts, and other pertinent data indicating proposed materials, accessories, details, and construction information.
- B. Certification: Transmit a Manufacturer's Certification or cut sheets indicating compliance, based on manufacturer's routine quality tests showing that pipe, precast structures and castings meet or exceed the requires of these specifications or requirements in the reference to Island County standards (including specifications, plans and details).
- C. Transit reports indicating field tests performed and results obtained.
- D. Construction Work Plan
 - 1. Submit a work plan to the Resident Engineer for review. Work plans shall include the following elements:
 - a. Temporary sewer bypass, if required, including a list of all equipment being used. Work plan shall include data to document required size of pumps, provisions for redundancy, alarms, alarm monitoring and noise mitigation as required.

- b. Work plan shall include elements for restrictions in Island County right-of-way and identification and protection of existing utilities.
 - c. The Owner's review of work plans does not relieve the Contractor of its responsibilities or of any public liability for sewage spills.
- E. Transmit Record Documents: Show actual locations of manholes, cleanouts, later sewers, building or side sewers, and pipe inverts at manholes with as-built documentation.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section shall have a minimum of three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this Section shall have a minimum three (3) years documented experience.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA FOR UTILITY SUPPORT

- A. Design and maintain utility support system for utilities crossing sewer trenching and excavation so that the vertical deflection of utility does not exceed existing or proposed design slopes.

2.02 BYPASS PUMPING CRITERIA

- A. If bypass pumping is required for the connection to existing sanitary sewer system, the Contractor shall include this element in the Construction Work Plan required herein for review by Ben Franklin Transit and Island County. Contractor shall determine pump sizing with all pumps in operation and with one pump out of service. Night operation of bypass pumping will require a high-alarm with telemetry or full-time watch.

2.03 PIPE

- A. Sewer pipe shall have conform to Section 7-17.2 of the WSDOT Standard Specifications. All pipe and fittings shall be legibly and permanently marked with type and class.

2.04 MANHOLES

- A. Manholes shall be precast concrete structures conforming to Section 7-05.2 of the WSDOT Standard Specifications.

2.05 CLEANOUTS

- A. Cleanouts shall be of the same material as the pipe and shall conform with Section 7-19.2 of the WSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notify Owner at least 20 days prior to beginning work associated with the new or existing sanitary sewer system. In addition to Resident Engineer's inspection, Ben Franklin Transit may provide its own inspection services for the Work associated with the public sanitary sewer system.
- B. Inspection: Inspect pipe before it is installed. Remove defective products for the project site.

3.02 CONSTRUCTION

- A. Excavate trenches for utility installation in accordance with jurisdictional and state standards.
- B. Dewatering: Keep excavations free of water during excavation, installation of pipeline, and placement of bedding and trench backfill. Control surface run-off so as to prevent entry or collection of water in excavations.
- C. Trench Safety and Support systems: Where trench excavation is deeper than 4 feet, construct and maintain safety systems that meet the requirements of WAC Chapter 296-155 Part N.
- D. Design and install utility support system to support and protect existing utilities which cross the sanitary sewer.
- E. Comply with Island County requirements for the construction and installation of the pipe, related structures, and other incidental work.
- F. Install manholes, re-channel existing manholes, and make manhole and manhole-stub pipe connections to existing in accordance with Island County requirements.
- G. Temporary Sewer Bypass: Install a temporary bypass to maintain uninterrupted Sewer service as required. Install a bypass system that diverts the effluent flow at an upstream access manhole and pump it through a separate conduit to a downstream reentry point. Size the pump and bypass conduit to adequately handle the flow. Size to ensure that the effluent level in the bypass pumping manhole does not rise more than 1 foot above the crown of the lowest incoming sewer pipe.
- H. When connecting new pipe to existing pipe where materials differ, use only new pipe having the same inside diameter as the existing. Match inverts, grade, and alignment. Connect joints between pipes with a mismatched wall thickness with a flexible gasketed coupling, adapter or coupling-adapter to make watertight joint.
- I. Leave building or side sewer connections and sewer mains uncovered until the Owner and Island County has inspected and approved the work.

3.03 PIPE

- A. Pipe shall be installed in conformance with Section 7-17.3 and 7-18.3 of the WSDOT Standard Specifications.

3.04 MANHOLES

- A. Installation of manholes shall conform with Section 7-05.3 of the WSDOT Standard Specifications.

3.05 CLEANOUTS

- A. Cleanouts shall be installed in conformance with Section 7-19.3 of the WSDOT Standard Specifications.

3.06 CLEANING AND TESTING

- A. All sewers and appurtenances shall be cleaned and tested after backfilling by the low pressure air method specified in Section 7-17.3(2) of the WSDOT Standard Specifications.

END OF SECTION

SECTION 33 40 00

STORM DRAINAGE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Section includes requirements for providing the stormwater drainage system, including but not limited to, drainage pipes, infiltration pipes, culverts, related drainage structures, catch basins, storm manholes, and the related case iron and steel products required for gratings, covers and manhole steps and ladders.

1.02 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the latest version of the Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the Washington State Department of Transportation (WSDOT), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.03 SUBMITTALS AND TRANSMITTAL

- A. Product Data: Transmit catalog cuts, and other pertinent data indicating proposed materials, accessories, details, Manufacturer's installation instructions, Certificate of Compliance or cut sheets indicating compliance based upon the manufacturer's routine quality control tests showing that pipe, precast structures and castings meet or exceed the requirements of these specifications and other relevant construction information.
- B. Transmit Record Documents: Record location of pipe runs, connections, catch basins, manholes, cleanouts, and invert elevations with as-built documentation.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section shall have a minimum of three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this Section shall have a minimum three (3) years documented experience.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling.
- B. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Protect seals from dirt and damage.
- C. Before, during and after installation, plastic pipe and fittings shall be protected from many environments that would result in damage or deterioration to the material.
- D. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless otherwise directed by the Owner.
- E. Handle pipe, fittings, and other accessories in such a manner as to ensure

PART 2 - PRODUCTS

2.01 PIPE

- A. Drainage pipe shall conform to Section 7-04.2 of the WSDOT Standard Specifications.

2.02 BEDDING AND BACKFILL MATERIAL

- A. Pipe bedding shall conform to WSDOT Standard Specifications Section 9-03.12(3).

2.03 CATCH BASINS AND MANHOLES

- A. Catch basins and manholes shall be precast concrete structures conforming to Section 7-05.2 of the WSDOT Standard Specifications.

2.04 FILTER FABRIC

- A. Filter fabric for separation shall conform to Section 9-33.2(1) of the WSDOT Standard Specifications.

2.05 CLEANOUTS

- A. Cleanouts shall be of the same material as the pipe and shall conform to Section 7-19.2 of the WSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Stop work and promptly notify Owner if stormwater lines not shown on the plans are encountered.

- B. Verify size, material, joint type, elevation, and horizontal location of existing pipelines and structures to be connected to new pipeline.
- C. Clearly identify and promptly set aside defective or damaged pipe.

3.02 CONSTRUCTION

- A. Maintain uninterrupted service with temporary storm sewer bypassing when construction work will interfere with storm water flow in existing storm sewer system and roadside ditches.
- B. Pipe shall be installed in conformance with Section 7-04.3 of the WSDOT Standard Specifications.
- C. Catch basins and manholes shall be installed in conformance with Section 7-05.3 of the WSDOT Standard Specifications.
- D. Culvert shall be installed in conformance with Section 7-02 of the WSDOT Standard Specifications.
- E. Cleanouts shall be installed in conformance with Section 7-19.3 of the WSDOT Standard Specifications.
- F. Trench Safety and Support Systems: Where trench excavation is deeper than 4 feet, construct and maintain safety systems that meet the requirements of the Washington Administrative Code (WAC) Chapter 296-155 Part N. Comply with excavation support and protection requirements as stated elsewhere in the Contract Documents.
- G. All storm drains and appurtenances shall be cleaned and tested in accordance with the low pressure air method specified in Section 7-04.3(1) of the WSDOT standard specifications.

END OF SECTION