

**SECTION 00 01 01
PROJECT TITLE PAGE**

**PORT OF TACOMA
TACOMA, WASHINGTON
PIER 4 PHASE 2 RECONFIGURATION**

**PROJECT NO. 091251
CONTRACT NO. 070136**

VOLUME 2 OF 3 - PROJECT MANUAL (MARINE BUILDING)

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PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 35 19.01 - "Concrete Finishing" for polishing at concrete floor slabs.
 - 2. Structural Drawings – Structural Notes

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.
 - 4. Concrete 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. W/C Ratio: The ratio by weight of water to cementitious materials.

1.04 PREINSTALLATION CONFERENCE:

- A. Before submitting design mixtures, conduct a preinstallation conference at the project site to review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - 1. Contractor's superintendent.
 - 2. Ready-mix concrete manufacturer.
 - 3. Concrete contractor.
 - 4. Reinforcing placement contractor.
 - 5. Engineer (and design professionals)
 - 6. Special Inspector.
- B. Review the following:
 - 1. Special inspection and testing procedures for field quality control.
 - 2. Concrete finishes and finishing.
 - 3. Cold- and hot-weather concreting procedures.
 - 4. Curing procedures.
 - 5. Construction contraction and isolation joints, and joint-filler strips.
 - 6. Semirigid joint fillers.

7. Forms and form removal limitations.
8. Vapor-retarder installation.
9. Anchor rod and anchorage device installation tolerances.
10. Steel reinforcement installation.
11. Floor and slab flatness and levelness measurement.
12. Concrete repair procedures.
13. Concrete protection.

1.05 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. Include either the "Field Experience Method Form" or the "Trial Batch Method Form", provided in this specification. Fill out the forms in their entirety.
 2. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical couplers, tie 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 Engineer.
- F. Contraction Joint Layout: Indicate proposed location of contraction joints not shown on the drawings.
- G. Samples: For waterstops and vapor retarder

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer
- 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. Vapor retarders.
 10. Semirigid joint filler.
 11. Joint-filler strips.
 12. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates.
- E. Evaluation Reports: ICC-ES or IAPMO-ES report certifying product compliance with IBC 2012 for each of the following:
1. Headed Deformed Bars.
 2. Mechanical Bar Couplers.
 3. Adhesive anchors for deformed steel reinforcing bars.
- F. 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 301/301M, respectively.
- G. Floor surface flatness and levelness measurements: indicating compliance with specified tolerances.

1.07 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."
 2. Grade II lab technical certification required for mix design.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.
- D. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, (construction, tooled, saw-cut) surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Engineer.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 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

1.09 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 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 301 (ACI 301 M) and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 REDESIGN

- A. Redesign or Departures from Requirements of the Contract Documents Initiated by Contractor:
 - 1. Obtain written acceptance from the Engineer.
 - 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.

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 (ACI 301M).
2. ACI 117 (ACI 117M).

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Not applicable.
- 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. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. 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.
- F. 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 to the plane of exposed concrete surface.

2.03 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn, galvanized.
- C. 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, 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. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- C. Headed Deformed Bars: ASTM A 970/A 970 M.

2.05 CONCRETE MATERIALS

- A. 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.
- B. Cementitious Materials:
 1. Portland Cement: ASTM C 150, Type I/II, gray.

- a. Fly Ash: ASTM C 618, Class F or C.
- C. Normal-Weight Aggregates: ASTM C 33, 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 reinforcing bars or between reinforcing bars and forms.
 - b. One-fifth of the narrowest dimension between the sides of the forms.
 - c. One-third of the thickness of the slabs or toppings.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260.
- E. 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.
- F. 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. Manufacturer / Product:
 - 1. Waterstop-RX bentonite waterstop and water-based adhesive as manufactured by Colloid Environmental Technologies Company (CETCO), www.cetco.com, 847-392-5800: Waterstop-RX 101T.
 - a. Equal as approved by Engineer.
 - 2. Accessories: Provide all accessories, adhesives and other items as recommended by the manufacturer for a complete system.

2.07 VAPOR RETARDERS

- A. Sheet Vapor Retarder (AKA Vapor Barrier): ASTM E 1745, Class A. Permeance as tested before and after mandatory conditioning (ASTM E 1745 Section 7.1 and sub-paragraphs 7.1.1-7.1.5): less than 0.01 Perms (grains / (ft² x hr x in Hg)). Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers / Products:
 - a. Fortifiber Corporation; Moistop Ultra 15.
 - b. Stego Industries, LLC.: Stego Wrap Vapor Barrier (15 mil).
 - c. Griffolyn; Vapor Guard.
 - d. Monarflex; Reflex Super.
 - e. Or equal as approved by Engineer

2.08 LIQUID FLOOR TREATMENTS

A. Concrete Sealer:

1. Manufacturer / Product: L&M Construction Chemicals, "PermaGuard SPS" installed with primer as/if recommended by the manufacturer, or equal as approved by the Engineer.
2. Locations: Install at interior exposed concrete slabs scheduled as "CS" (Clear Sealer). This applies only to exposed slabs that are not scheduled to be stained, colored, or polished concrete. Stained, colored or polished concrete floors have a different sealer system as specified in Division 3 Section "Concrete Finishing".

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. 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.

2.10 RELATED MATERIALS

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

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch 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 or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi 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 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 or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: See structural General Notes.

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.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent maximum.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Slag Cement: 50 percent.
 4. Combined Fly Ash or Pozzolan and Slag Cement: As approved by the Engineer, 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions, and as compatible with specified mix design.
 1. Use water-reducing or plasticizing 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 ASTM C 1116/C 1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, 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 than may be added at the site, if any.
- B. 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 for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch 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. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

- L. 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 for 24 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 7 days and until concrete has achieved at least 70 percent of its 28-day design compressive strength, whichever is longer.
 - 1. Remove in conformance with submitted Shoring, Backshoring and Reshoring Procedure formwork that supports weight of concrete in place.
 - 2. Forms that support post-tensioned concrete may be removed after post-tensioned tendons have been stressed and approved by the Engineer.
- 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 Engineer.

3.04 VAPOR RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 2. Seal to penetrations at pipes, conduits, and all other penetrations.
- 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" 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.
- 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 Port:
 - 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 Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Roughen surfaces of joints to full amplitude of approximately 1/4 inches as indicated.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint where indicated.
- D. Saw Cutting: Saw Cut joints only after concrete has gained sufficient strength to resist damage by sawing, including rough, chipped or spalled edges, but prior to the formation of random cracking.

3.07 WATERSTOP INSTALLATION

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

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. 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.
- C. 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 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.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.09 FINISHING FORMED SURFACES

- A. Not Applicable

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. 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, and to receive mortar setting beds for bonded cementitious floor finishes.

- 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 restraightening 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 restraighten 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. Unless noted otherwise, apply a trowel finish to surfaces exposed to view, to be covered with resilient flooring, carpet, and ceramic or quarry tile set over a cleavage membrane.
 2. Do not over-trowel concrete surface at polished, stained or colored concrete floors. Trowel to level for optimal surface condition for colored and polished concrete finish application. Coordinate with polished/stained concrete material manufacturer and installer.
 3. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Carpeted Floors: 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. Hard Surface Flooring, such as VCT, Ceramic Tile, Sheet Vinyl, Rubber Tile, etc.: 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. Hard Surface Flooring, such as VCT, Ceramic Tile, Sheet Vinyl, Rubber Tile, etc.: 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. All Exposed Concrete Floors such as Sealed Concrete and Stained, Colored or Polished Concrete Floors: 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.
 - e. Finish Floor Flatness at Walls: No "dip" will be allowed at walls.
- 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 thin-set method, and other locations indicated. 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, sidewalks, 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 Engineer 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 301/301M 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 it the Curing Procedures demonstrate that moisture loss will not exceed 0.2 lb/sq. ft. 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 lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies 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 unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
 - 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.
- F. If water is used for curing it must be disposed of according to the Port.

3.13 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. 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 deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer'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 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 in any dimension to solid concrete. Limit cut depth to 3/4 inch. 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 Engineer.
- 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 wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer'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 Engineer.
1. Cracks in excess of 0.01 inch which extend through the full depth of a slab or wall
 2. Cracks in excess of 0.015 inch 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 Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: The Port will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Tests and Inspections: As indicated on the structural drawings.
- C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- D. 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 Engineer. 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 Engineer.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- F. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- G. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

END OF SECTION

CONCRETE MIX DESIGN SUBMITTAL – FIELD EXPERIENCE METHOD

Project	_____	Mix Design No	_____
General Contractor	_____	Concrete Class	_____
Ready Mix Supplier	_____	Proposed Use	_____
Plant Supplying Con-	_____		

MIX CONSTITUENTS

	Description	Specific Gravity	Weight (lb) or Dosage (oz)	Absolute Volume (cubic foot)
	Cement			
	Fly Ash			
	Silica Fume			
	Coarse Aggregate			
	Fine Aggregate			
	Water			
	Admixtures			
	Water Reducer			
	Air Entrainment			
	High Range Water Reducer			
	Other			
	Total			

MIX CHARACTERISTICS

Water / Cementitious Ratio	_____	Slump (in)	_____
Air (%)	_____	Before High Range Water Reducer	_____
Density (pcf)	_____	After High Range Water Reducer	_____

CONCRETE MIX DESIGN SUBMITTAL – FIELD EXPERIENCE METHOD (CONTINUED)

REQUIRED BACK –UP DATA

NOTE: THE SUBMITTED DATA SHALL COMPLY WITH THE FOLLOWING:

	Yes	No
• Ten test reports (minimum) provided.	<input type="checkbox"/>	<input type="checkbox"/>
• The reports encompass a period of not less than 60 days.	<input type="checkbox"/>	<input type="checkbox"/>
• The reports are no more than 12 months old.	<input type="checkbox"/>	<input type="checkbox"/>
• The reports are for concrete supplied from the same plant that will be supplying this project.	<input type="checkbox"/>	<input type="checkbox"/>
• Submitted test data is supported by reports from an independent testing agency, and the independent agency's reports are available at the Engineer's request.	<input type="checkbox"/>	<input type="checkbox"/>

REQUIRED STATISTICAL ANALYSIS

METHOD FOR DETERMINING REQUIRED AVERAGE COMPRESSIVE STRENGTH
(PICK ONE)

- ☐ ACI 301 Section 4.2.3.3.a – Standard Deviation
15 tests minimum required

Specified compressive strength (psi) _____

Calculated standard deviation of submitted data, s_s (psi) _____

Factor from Table 4.2.3.3.a.1, k _____

Required average compressive strength from
Table 4.2.3.3.a, f'_{cr} (psi) _____

Calculated average strength of submitted data (psi) _____

- ☐ ACI 301 Section 4.2.3.3.b – Standard Deviation Not Required

Specified compressive strength (psi) _____

Required Average Strength from Table 4.2.3.3.b, f'_{cr} (psi) _____

Calculated average strength of submitted data (psi) _____

REQUIRED ATTACHMENTS (Please Check)

- | | |
|---|---|
| <input type="checkbox"/> Field Test Data | <input type="checkbox"/> Coarse Aggregate Gradation |
| <input type="checkbox"/> Statistical Analysis | <input type="checkbox"/> Fine Aggregate Gradation |
| <input type="checkbox"/> Certification that all ingredients are compatible. | |

CONCRETE MIX DESIGN SUBMITTAL – TRIAL BATCH METHOD

Project _____ Mix Design No _____
General Contractor _____ Concrete Class _____
Ready Mix Supplier _____ Proposed Use _____
Plant Supplying Concrete _____

MIX CONSTITUENTS

	Description	Specific Gravity	Weight (lb) or Dosage (oz)	Absolute Volume (cubic foot)
Cement				
Fly Ash				
Silica Fume				
Coarse Aggregate				
Fine Aggregate				
Water				
Admixtures				
Water Reducer				
Air Entrainment				
High Range Water Reducer				
Other				
Total				

MIX CHARACTERISTICS

Water/Cementitious Ratio _____ Slump (in) _____
Air (%) _____ Before High Range Water Reducer _____
Density (pcf) _____ After High Range Water Reducer _____

CONCRETE MIX DESIGN SUBMITTAL – TRIAL BATCH METHOD (CONTINUED)

DOCUMENTATION OF AVERAGE STRENGTH

NOTE: THE SUBMITTED DATA SHALL COMPLY WITH THE FOLLOWING:

	Yes	No
• At least three trial mixtures are included	<input type="checkbox"/>	<input type="checkbox"/>
• At least three different cement contents are included.	<input type="checkbox"/>	<input type="checkbox"/>
• At least three different water / cementitious materials ratios are included.	<input type="checkbox"/>	<input type="checkbox"/>
• The trial batches are no more than 12 months old.	<input type="checkbox"/>	<input type="checkbox"/>

REQUIRED STATISTICAL ANALYSIS

METHOD FOR DETERMINING REQUIRED AVERAGE COMPRESSIVE STRENGTH (PICK ONE)

- ☐ ACI 301 Section 4.2.3.3.a – Standard Deviation
15 tests minimum required from the plant supplying the concrete

Specified compressive strength (psi)

Calculated standard deviation of submitted data, s_s (psi)

Factor from Table 4.2.3.3.a.1, k

Required average compressive strength from
Table 4.2.3.3.a, f'_{cr} (psi)

Average strength of proposed mix, obtained from plot of submitted
trial batch date (psi)

- ☐ ACI 301 Section 4.2.3.3.b – Standard Deviation Not Required

Specified compressive strength (psi)

Required Average Strength from Table 4.2.3.3.b, f'_{cr} (psi)

Average strength of proposed mix, obtained from plot of submitted
trial batch date (psi)

REQUIRED ATTACHMENTS (Please Check)

- | | |
|---|---|
| <input type="checkbox"/> Plot of compressive strength versus water / cementitious materials ratio | <input type="checkbox"/> Certification that all ingredients are compatible. |
| If standard deviation is calculated: | <input type="checkbox"/> Coarse aggregate gradation |
| <input type="checkbox"/> Field test data | <input type="checkbox"/> Fine aggregate gradation |
| <input type="checkbox"/> Statistical Analysis | |

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 30 00.01 – “Cast-in-Place Concrete” for general building applications of specially finished concrete.

1.02 SUMMARY

- A. This Section specifies concrete polishing with sealers and hardeners associated with the polishing system.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include specifications, test data, technical data sheet, MSDS, surface preparation and application instructions, and maintenance and cleaning instructions.
- B. Qualification Data: Information establishing the qualifications of installers and manufacturers as required in this Section.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in concrete polishing and sealer products.
- B. Source Limitations: Obtain each type of concrete sealer and hardener from a single manufacturer and concrete polishing from a single manufacturer.
- C. Installer Qualifications: An experienced installer, who has completed concrete polishing work similar in type, design and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance. Installer shall have a minimum of 5 years of experience with similar products and shall have successfully completed a minimum of 10 applications of specified stain and polishing products. The installer shall have all recommended training by the manufacturer, and shall be acceptable to the manufacturer. Provide letter stating such.
- D. Manufacturer's Representative: The concrete polishing manufacturer's technical representative shall attend the preinstallation meeting, shall be on-site the first full day of polishing operations, shall make periodic site inspections thereafter, and shall provide written reports to the Contractor, and Engineer for every visit documenting his/her observations, corrective directions given, and photographs taken. The report shall be provided within 5 working days of the visit.
- E. Mockups: Before proceeding with polishing of areas to receive concrete polishing, provide mockup test area to demonstrate concrete polishing finish, control joints with filler, hardeners and sealers, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Engineer.
 - 2. Build mockups of typical interior concrete slab with polished and sealed concrete finish, a minimum of 4 x 8 feet, including sample construction and control joints. Repeat until such time as the Engineer is satisfied with the finished appearance.

3. In presence of Engineer, damage part of the exposed-face mock-up surface and demonstrate materials and techniques proposed for repair of surface blemishes to match adjacent undamaged surfaces.
 4. Obtain Engineer's approval of mockups before proceeding with full installation.
- F. Preinstallation Conference: Conduct conference at Project site.
1. Require representatives of each entity directly concerned with cast-in-place concrete and concrete stain installation to attend, including the following:
 - a. Contractor's superintendent.
 - b. Concrete subcontractor.
 - c. Concrete polishing manufacturer's representative.
 - d. Concrete supplier.
 - e. Port's testing agency.
 - f. Port.
 - g. Engineer.
 2. Review concrete finishes, curing procedures, concrete repair procedures, concrete protection, concrete control joint procedures and requirements, surface preparation, sealing and polishing application, protection, appearance requirements, and coordination with other work including: safety, notifications, emergency procedures, redundancy/spares, etc.
- G. Test Reports: Prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name, lot number, date of manufacture, etc.
- B. Store sealers and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store materials in a clean, dry area indoors in accordance with manufacturer's instructions. Keep containers sealed until ready for use.
1. Concrete Floor Hardener / Sealer: Keep away from ignition sources. Do not allow to freeze.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.06 PROJECT CONDITIONS

- A. Maintain air and surface temperatures within range recommended by manufacturer, but not less than 40 deg F or more than 85 deg F, in spaces to receive concrete stain, and not less than 55 deg F or more than 85 deg F, in spaces to receive sealers during the following time periods:
1. 48 hours before installation.
 2. During installation.

3. 48 hours after installation.
- B. Cure concrete for a minimum of 45 days before commencing with polishing system.
- C. After post-installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- D. Close spaces to traffic during stain and polishing installation.
- E. Close spaces to traffic for 48 hours after installation.
- F. Perform polishing after other finishing operations, including painting, have been completed, except "initial grind" which may be completed earlier. Install wall base material after sealers and hardeners are completed and cured.

1.07 WARRANTY

- A. Special Installer's Warranty: Polished Concrete System Installer's warranty, signed by Installer, in which Installer agrees to repair floors that fail in materials or workmanship within specified warranty period.
 1. The system shall remain hardened, dust proof and water-repellent for the warranty period.
 2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CONCRETE POLISHING/HARDENING/SEALING

- A. System Basis-of-Design Product: The system design is based on the RetroPlate System, manufactured by ADVANCED FLOOR PRODUCTS, 801-812-3420, www.retroplatesystem.com. Installation shall be by a certified RetroPlate applicator only. Subject to compliance with requirements, provide the basis of design product, or comparable product by one of the following
 1. Perma-Shine.
 2. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Concrete Hardener / Sealer: "RetroPlate 99", or an equivalent product from an approved manufacturer.
 1. Performance Criteria:
 - a. Abrasion resistance: ASTM C779 – up to 400% increase in abrasion resistance.
 - b. Impact Strength: ASTM C805 – Up to 21% increase in impact strength.
 - c. Ultra Violet Light and Water Spray: ASTM G23-81 – No adverse Affect to ultra violet light and water spray.
 - d. Reflectivity: Up to 30% increase in reflectivity.
- C. Slip Resistance: Floor shall meet national ANSI A117 Standards for slip resistance.
- D. Topcoat Sealer: "RetroGuard", manufactured by Advanced Floor Products, or an equivalent product from an approved manufacturer. Installed by an applicator certified by the system manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of stain products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 3. Notify Engineer of all unsatisfactory conditions and proposed remedies.

3.02 PREPARATION

- A. Protection:
 - 1. Protect walls and surrounding surfaces not to receive concrete floor sealers or hardeners.
 - 2. Do not allow sealers or hardeners to come in contact with wood or metal surfaces, or other materials that might be damaged by sealers or hardeners.
 - 3. No satisfactory procedure is available to remove petroleum stains from concrete. Remove and replace any concrete that receives a petroleum stain.
 - 4. Diaper all hydraulic equipment to be moved over slabs that are to receive polishing system.
 - 5. Do not park vehicles over slabs to receive polishing system.
 - 6. Do not cut pipe over slabs to receive polishing system.
 - 7. Do not place steel on slabs to receive polishing system (to avoid rust stains).
 - 8. Use non-marking tires on all equipment.
 - 9. Close areas to traffic during polishing process.
- B. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of stain products.
- C. Concrete shall be as specified in Division 3 Sections "Cast-In-Place Concrete". See structural plans and notes for additional requirements at exposed slabs including added reinforcing and additional curing requirements. Plan on allowing concrete to cure a minimum of 60 days. Provide temporary heat as necessary to facilitate slab curing. Test for moisture prior to the stain application, using relative humidity probe according to ASTM 2170. Readings must be 80% or below before applying the sealer. Calcium Chloride Test of 3lbs/1000 sq ft/24hr is also acceptable. Manufacturer's recommendations for application shall supercede these requirements.
- D. Concrete Substrates: (Testing by Contractor)
 - 1. Verify that slab meets specified surface flatness.
 - 2. Verify concrete surface is clean, dry, structurally sound, and free from dirt, dust, oil, grease, solvents, paint, wax, asphalt, concrete curing compounds, sealing compounds, surface hardeners, bond breakers, adhesive residue, and other surface contaminants.
 - 3. Do not acid wash or use heavy alkali cleaners.

4. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
5. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform tests recommended by manufacturer. Provide test results to Port prior to proceeding. Proceed with installation only after substrates pass testing.
- E. Remove substrate coatings and other substances that are incompatible with stain and that contain soap, wax, oil, or silicone, using methods recommended by manufacturer.
- F. Use approved methods to fill cracks, holes, and depressions in substrates.
- G. Sweep, vacuum and mop clean substrates to be covered by stain products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 POLISHING AND STAIN INSTALLATION

- A. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup. Grind floors to within ¼ inch of the finished wall surface at walls with a base material. At concrete block walls, grind all the way to the face of concrete block wall. Stage grinding such that initial grinding is done before steel stud walls are erected to assure grinding continues to face of studs. Immediately cover and protect floors by approved methods.
 - a. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete concrete polishing.
 - b. Grind concrete floors scheduled to receive a stained finish to a level 2, 800 diamond, "wax" finish, except as stair treads, grind to a 400 diamond finish.
 - c. At areas requiring hand grinding, complete to similar level and large machine grinding for uniform appearance.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.

3.04 SEALER INSTALLATION

- A. Polish concrete in accordance with manufacturer's instructions. Polished concrete to meet applicable code requirements for slip resistance.
 1. Topcoat Sealer: Topcoat sealer system shall consist of two coats of RetroGuard. The RetroGuard shall be applied as received.

2. Each coat shall be applied at 1000 sq ft per gallon. Keep material containers closed when not in use to avoid contamination. Keep product from freezing.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations after completing stain and sealer installation, following manufacturers recommended curing times:
 1. Protect stained concrete floor from damage during construction.
 2. Protect concrete surfaces from foot traffic for a minimum of 24 hours.
 3. Avoid washing concrete surfaces for a minimum of 48 hours.
 4. Sweep and vacuum surfaces thoroughly.
 5. Damp-mop surfaces to remove marks and soil.
- B. Protect polished concrete floors from mars, marks, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
 - a. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 - b. No trade may park vehicles or other equipment on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
 - c. No pipe cutting machine welding, grinding, or other similar operations may be used over the floor slab.
 - d. Steel shall not be placed on interior slab to avoid rust staining.
 - e. Acids and acidic detergents will not come into contact with slab.
 - f. All trades shall be informed that the slab must be protected at all times.
 2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over floor and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 35 19.01 - "Concrete Finishing" for polishing at concrete floor slabs.
 - 2. Structural Drawings – Structural Notes

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Grout not specified in other Sections, including:
 - a. Epoxy grout.
 - b. Grout for hollow-metal frame assemblies.
 - 2. Patching underlayment for concrete slabs to receive finish flooring.
- B. Work in Other Sections
 - 1. Grout for structural steel base plates specified in Division 5 Section "Structural Steel Framing."
 - 2. Grout for setting metal fabrications specified in Division 5 Section "Metal Fabrications."
 - 3. Grout for tile work specified in Division 9 Section "Ceramic Tile".

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the conditions of the Contract and Division 01 Specification Sections.
- B. Brochures: Submit brochures and product data sheets for grout materials proposed for use in the work; obtain Engineer's approval.
- C. Certificates: Submit certificates from the manufacturer attesting that grout materials meet the requirements specified herein.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver grout and underlayment materials in unopened original containers with original labels thereon; keep sealed until containers and materials have been approved by Engineer.
- B. Store materials in approved safe weathertight area; store and handle materials in a manner which will prevent the inclusion of foreign materials and damage by water or dampness.

1.05 PROJECT CONDITIONS

- A. Weather: Do not install grout materials when weather conditions jeopardize grout strength or curing, or when conditions fall outside of the manufacturer's recommendations for installation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Epoxy Grout
 - 1. Master Builders "Paste LPL", or equivalent product; mix in accord with manufacturer's instruction and recommendations for particular conditions of installation in each case.

2. Where a sand/epoxy mix is used, use only a blended sand mix as recommended by the epoxy manufacturer.
- B. Patching Underlayment for Concrete Slabs:
 1. Furnish "Mapei" Plani/Patch PRP 110 fast-setting, cement-based, polymer-modified patching compound, or equivalent product, having a minimum compressive strength at 28 days of 4,000 psi. Do not exceed 1/2" in thickness without approval of the manufacturer and Engineer. Verify acceptability with various flooring manufacturers, and do not proceed where any objections or conflicts exist. This is not an approved product for use at slabs that will be exposed to view in the finished project.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Preparation of Surfaces
 1. Clean all surfaces to receive grout free of dirt, oil, wax, asphalt, latex compounds, curing compounds, grease and loose material and any contaminant which might act as a bondbreaker.
 2. All metal components to be in contact shall be de-rusted and free of paint or oils.
 3. All concrete and masonry to come into contact with the grout shall be thoroughly saturated following manufacturer's recommendations prior to placement of grout; remove excess water from voids just prior to grout placement.
 4. Check that hollow metal door and relite frames are secured in place.

3.02 INSTALLATION

- A. Grout Installation
 1. General:
 - a. Install products where indicated; fill joints, voids, pockets, etc., completely full.
 - b. Finish exposed surfaces level and smooth.
 - c. Comply with manufacturer's recommendations and limitations.
 2. Additional Requirements for Epoxy Grouting;
 - a. Install epoxy grout fill around items recessed in floor slabs such as guardrails and similar items.
 - b. Install epoxy grout at all stud holes in concrete copings; fill holes completely, flush with top surface of coping.
 - c. Install epoxy grout at all other locations indicated.
 - d. Exposed grouted surfaces shall be uniform in appearance and finished to match color and texture of adjacent existing concrete surface, to the satisfaction of the Engineer.
- B. Underlayment Installation:
 1. Apply patching underlayment as specified above over properly prepared substrate as required to level and prepare concrete slabs for finished flooring installation, and to fill all concrete slab and topping slab control joints in interior concrete slab surfaces to receive resilient and carpet floor coverings and ceramic tile. Joints shall be finished flush with adjacent slab surfaces. Do not install in joints of slabs to be left exposed in final

construction. Follow manufacturer's recommendations and installation instructions for mixing and installing underlayment.

2. Remove all excess underlayment material from adjacent floor surfaces.
3. Do not install at concrete slabs to be left exposed in final construction.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.
 - 1. Section 01 45 00.01 - "Quality Control" for independent testing agency procedures and administrative requirements.
 - 2. Section 05 31 00.01 - "Steel Decking" for field installation of shear connectors through deck.
 - 3. Section 05 50 00.01 - "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items.
 - 4. Section 05 51 00.01 - "Metal Stairs."
 - 5. Section 09 96 00.01 - "High Performance Coatings" for coating of all exposed steel.
 - 6. Structural Drawings – Structural Notes.

1.02 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
 - 3. Primers.

- B. Related Sections:

1.03 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Discontinuities resulting from fabrication and erection procedures and connections of structural and nonstructural elements are limited in the protected zone.
- D. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.
- B. Welding certificates.
- C. Primer and Top Coat Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats. Provide certification from primer manufacturer for preparation requirements for compatibility with top coat.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Non-shrink grout.
- F. Source quality-control reports.
- G. Certified Manufacturer's Test Reports
1. Charpy V-Notch (CVN) impact test results for the following:
 - a. Filler metal for Demand Critical Welds.
- H. Design Calculations: Submit design calculations, bearing the seal and signature of a Professional Engineer, employed by the Contractor and registered in the state of the project, for the following:
1. Connections that differ from that indicated in the contract documents.
 2. Requests for substitution of member sizes or material grades.
 3. Modification of the strength or configuration of structural framing for the convenience to accommodate the erection sequence, construction equipment, and/or material availability.
 4. Calculations shall be in conformance with the reference standards cited herein and shall clearly demonstrate applicability for the intended use.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Shop-Painting Applicators: Apply primer in accordance with standards and methods listed in High Performance Coatings Section 09 96 00.01. Apply professionally without runs drips or sags.
- C. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel" and WABO (or approved equal) requirements.
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 358.
 - 4. AISC 360.
 - 5. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Pre-installation Conference: Conduct conference at Project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Port's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.08 COORDINATION

- A. Coordinate selection of shop primers with field applied topcoats. Comply with primer and coating manufacturers' recommendations to certify that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.09 REDESIGN

- A. Redesign or Departures from Requirements of the Contract Documents Initiated by Contractor:

1. Obtain written acceptance from the Engineer
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.

1.10 EXCEPTIONS TO AISC CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES

A. Revise Section 7.14, Correction of Errors, as follows:

The correction of minor misfits by moderate amounts of reaming or grinding, and the drawing of elements into line with drift pins, shall be considered to be normal erection operations. Errors that cannot be corrected using the foregoing means, or that require welding, cutting or changes in member or Connection configuration, shall be promptly reported to the Port's Designated Representatives for Design and Construction and the Fabricator by the Erector, to enable the responsible entity to either correct the error or approve the method of correction to be used by others."

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 1. Finish: Black except where indicated to be primed.
- G. Welding Electrodes: Comply with AWS requirements. Welding electrodes used in members and connections in the SLRS shall comply with the additional requirements of AWS D1.8.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 1. Finish: Hot-dip or mechanically deposited zinc coating.
 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- E. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- F. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- G. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- H. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- I. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.03 PRIMER

- A. Primer: All Exterior Steel (non-galvanized): Provide TNEMEC Series 394 "PerimePrime", @ 2.5-3.5 DFT/Miozinc Single Component moisture cured, or comparable product by Sherwin Williams, Carboline or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Galvanizing Repair Paint: Provide TNEMEC Series 394 PerimePrime, or comparable product by Sherwin Williams, Carboline or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.

2.04 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened or pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.07 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections, unless AISC Class B coating unless test to a class B coating slip co-efficient for faying surfaces.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. Interior Primed Steel: SSPC-SP 3, "Power Tool Cleaning."
 - 2. Exterior Steel: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by mfg to provide a minimum dry film thickness of 2.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 SOURCE QUALITY CONTROL

- A. Testing Agency: Port will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embeds for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embeds showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Light drifting will be permitted to draw the parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills, care being taken not to weaken the adjoining metal. If, in the opinion of the Engineer, the extent of the reaming is such that holes cannot be properly filled or accurately adjusted after reaming, the faulty member shall be discarded and replaced with a new one, and all costs and expenses resulting shall be paid by the Contactor.
- H. No cutting of sections, either flanges, webs, stems or angles, shall be done by the Contractor without the consent of the Engineer, unless this cutting is particularly specified or shown on the drawings.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- J. Corrective Measures
 - 1. Any errors in locations or inaccuracies in the setting of anchor bolts, base plates, bearing plates, or other items of attachment or support for steel work shall be reported to the Engineer, and shall be corrected in a manner subject to the approval of the Engineer.
 - 2. Any misfits due to errors in fabrication shall be reported immediately to the Engineer, along with proposed method of correction of same and Engineer approval obtained before proceeding with corrective measures.
 - 3. No members shall be cut or burned without specific approval in writing.
 - 4. Bolted or welded connections, joints, or fastenings, which are classified as defective in the opinion of the Engineer, shall be corrected by the Contractor in a manner subject to the Engineer's approval.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened and pre-tensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
- C. Erection Connections, etc.: Place holes, plates, or other attachments required by the Erector so as not to interfere with or cause any other detrimental effect to structural members or their connections. Holes and attachments are limited in the Protected Zone.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: See structural drawings and Division 01 specifications.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Primer Repair: Immediately after erection, clean exposed areas where primer is damaged or missing and prime with TNEMEC Series 394. Prepair in accordance with SSPC Good Painting Practice Vol 1&II .
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 30 00.01 – “Cast-in-Place Concrete” for normal-weight and lightweight structural concrete fill over steel deck.
 - 2. Section 05 12 00.01 – “Structural Steel Framing” for shop- and field-welded shear connectors.
 - 3. Section 05 50 00.01 - "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 4. Section 09 96 00.01 – “High Performance Coatings” for painting of primed deck and finish painting of deck.
 - 5. Structural Drawings – Structural Notes.

1.02 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Composite floor deck.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, gauge, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, rib closures, and attachments to other construction. Indicate temporary deck shoring, where required.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Powder-actuated mechanical fasteners.
 - 2. Acoustical roof deck.
- D. Evaluation Reports: ICC-ES or IAPMO-ES report for steel deck.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Keep steel deck off ground on platforms or pallets. Slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230); cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Primer must be compatible with primer and finish coats specified under Division 9 Section "High Performance Coatings." Provide manufacturers recommended surface preparation requirements to achieve compatibility with intermediate and finishes.
 - a. Locations for Use: At all interior locations where decking is exposed to view.
 - b. Color: Manufacturer's standard Gray top surface with white underside.
 - 2. Deck Type: Profile, type, gauge and span condition as indicated on the structural drawings.
 - 3. Side Laps: As indicated on structural drawings.

2.03 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 - 1. Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230); cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Primer must be compatible with primer and finish coats specified under Division 9 Section "High Performance Coatings." Provide mfg of primer recommended surface preparation requirements to achieve compatibility with subsequent intermediate and finishes.
 - 2. Deck Type: Profile, type, gauge and span condition as indicated on the structural drawings.

2.04 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Where mechanical fasteners are indicated to be an acceptable fastener, fasteners are to be corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Where side-lap fasteners are indicated to be an acceptable fastener, fasteners are to be corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter, unless noted otherwise.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.03 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: As indicated on the structural drawings.
 - 2. Weld Spacing: As indicated on the structural drawings.
 - 3. Weld Washers: Install weld washers at each weld location where uncoated steel thickness is less than 0.028 inch.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated on the structural drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.04 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: As indicated on the structural drawings.
 - 2. Weld Spacing: As indicated on the structural drawings.
 - 3. Weld Washers: Install weld washers at each weld location where uncoated steel thickness is less than 0.028 inch.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated on the structural drawings.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.

- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.05 FIELD QUALITY CONTROL

- A. Special Inspections: See structural drawings and Division 01 specifications.
- B. Remove and replace work that does not comply with specified requirements.
- C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 REPAIRS AND PROTECTION

- A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on bottom surface of deck exposed to view of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting shall conform to SSPC Vol. I&II.
- B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in SSPC Vol. I&II.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 03 30 00.01 – “Cast-in-Place Concrete” for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 2. Section 05 12 00.01 Section – “Structural Steel Framing.”
 3. Sections 06 10 00.01 and 06 16 00.01 for metal framing anchors and timber connectors.
 4. Section 07 62 00.01 – “Sheet Metal Flashing and Trim” for coordination of gutter support brackets and spacer bars with fabrication of gutters.
 5. Section 07 72 00.01 – “Roof Accessories” for interface with roof hatches.
 6. Section 09 91 23.01 – “Painting” and Section 09 96 00.01 – “High-Performance Coatings” for field painting of primers installed under this Section.
 7. Section 10 14 00.01 – “Signage” for coordination of sign posts provided in this section with signs.
 8. Structural Drawing General Notes.

1.02 SUMMARY

- A. Section Includes:
1. Steel framing and supports for toilet compartments.
 2. Steel framing and supports for countertops.
 3. Steel framing and supports for mechanical and electrical equipment.
 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 5. Miscellaneous steel trim.
 6. Aluminum Ladders
 7. Steel bollards.
 8. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Miscellaneous Steel Fabrications: In addition to these items specifically listed in item ‘A’ above, the work in this Section includes all items fabricated from iron, steel, and aluminum shapes, plates, bars, strips and pipes, which are not a part of structural steel or other metal systems in other sections of these specifications, whether specifically specified herein or not.
- C. Products furnished, but not installed, under this Section:
1. Loose steel lintels.
 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 3. Steel weld plates and angles for casting into concrete or masonry for applications where they are not specified in other Sections.

1.03 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Metal nosing's.
 - 2. Primers.
 - 3. Grout.
- B. Shop Drawings: Shall be submitted for approval prior to fabrication. Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of all metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Primer Topcoats Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Primer Standards:
 - 1. Provide surface preparation method.
 - 2. Provide primer type.
 - 3. Provide the primer manufacturer's printed standards on surface preparation of exposed aged primer prior to finish coats.
 - 4. Provide primer manufacturer's printed information recommending compatible finish coats.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.07 PROJECT CONDITIONS

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

1.08 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with primer and coating manufacturers' written recommendations to warrant that shop primers and topcoats are compatible with one another. Comply with Informational Submittals Article, "Primer Top Coat Compatibility Certificates" requirements above.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.03 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
- F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.
- I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
 - 1. Dome head fasteners where indicated.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- G. Wood Screws: Flat head, ASME B18.6.1.
- H. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- I. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- J. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- K. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- L. Post-Installed Anchors:
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.05 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.06 PRIMER

- A. Type: Mio/Zinc single component moisture cure. TNEMEC Series 394-250 PerimePrime or equivalent as approved by Engineer. Mio/Zinc primer suitable for the following:
 - 1. Application over SP-3 Power Tool Cleaning.
 - 2. Class B coating for slip-critical faying connections.
 - 3. VOC compliant.
 - 4. Compatible with acrylic and two component finish systems.

2.07 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.08 VERTICAL ALUMINUM LADDERS FOR ROOF TO ROOF ACCESS:

- A. General: Fabricate ladders for the locations shown with dimensions, spacings, details, and anchorages as indicated. Comply with requirements of ANSI A14.3
- B. Provide Interior Vertical Ladders as follows:
 - 1. Provide Model #502 extruded 6063-T6 aluminum "Fixed Access Ladders" as manufactured by O'KEEFFE'S, INC. or approved substitute.
 - 2. Unit shall be complete with all necessary clips, fastenings, brackets, and accessories.
 - 3. Treads shall be formed from standard ladder rungs spaced as 12 inches o.c.
 - 4. Side rails shall be manufacturer's standard components.
 - 5. All welding shall be inert gas-shield arc, full penetration, fluxless type.
 - 6. Finish shall be mill finish.
 - 7. Ladder and accessories shall conform to all current requirements of O.S.H.A.
 - 8. Provide with extension safety post for use at all roof hatches, meeting ANSI A14.3 and O.S.H.A. requirements.

2.09 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated, and if not indicated, as recommended by partition manufacturer with attached bearing plates, anchors, and braces. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Prime using Mio/Zinc rust inhibitive primer, 2.5 mils DFT.
- E. Prime using Mio/Zinc miscellaneous framing and supports if not indicated to be galvanized.

2.10 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

2.11 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Prime using Mio/Zinc exterior miscellaneous steel trim.

2.12 STEEL BOLLARDS

- A. Fabricate bollards from Schedule 40 steel pipe, unless indicated otherwise on the drawings.
 - 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate, except where shown on drawings to be filled with concrete.
 - 2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Where bollard are indicated to be bolted to concrete slabs, fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4 inch (19 mm) steel machine bolt.
- E. Prime Bollards using TNEMEC Series 394 PerimePrime.

2.13 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates after fabrication where indicated.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL

- A. Comply with NAAMM's, SSPC for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.17 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified), unless indicated otherwise on the drawings.
- C. Where Aluminum Fabrications are indicated to be painted, prime per Section 09 91 23.01 "Painting" for Powder coating.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of Epoxy mastic.
2. Extruded Aluminum: Two coats of clear lacquer.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install steel columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
1. Grout baseplates of columns supporting steel girders after girders are installed and

3.03 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete, trowel concrete smooth, and allow concrete to cure seven days before installing.
- B. Where shown, anchor bollards to concrete slab construction with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
1. Embed anchor bolts at least 4 inches (100 mm) in concrete.
- C. Where shown, anchor bollards in concrete with pipe sleeves preset and anchored into concrete or in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.
- D. Where shown, anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Fill bollards solidly with concrete, mounding top surface to shed water, except where shown with metal caps.

3.04 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 INSTALLING SUPPORTS FOR TOILET PARTITIONS

- A. Anchor supports securely to and rigidly brace from overhead building structure.

3.06 ADJUSTING AND CLEANING

- A. Primer Repair: Immediately after erection, clean field welds, bolted connections, and abraded areas. Prime uncoated and abraded areas per SSPC Vol. I&II Good Painting Practices.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 03 30 00.01 – “Cast-in-Place Concrete” for concrete fill for stair treads and platforms.
 2. Section 05 50 00.01 – “Metal Fabrications” for metal treads and nosings installed at locations other than in metal stairs, and pre-engineered alternating tread stairs.
 3. Section 05 52 13.01 – “Pipe and Tube Railings” for metal railings.
 4. Section 06 10 00.01 – “Rough Carpentry” for blocking and backing for anchoring railings.

1.02 SUMMARY

- A. Section Includes:
1. Preassembled steel stairs (for the building interior) with precast concrete treads.
 2. Industrial-type stairs and catwalks with steel grating treads and landings at interior catwalks and the building exterior.
 3. Stair Tread and nosing insert.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m)
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

- C. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI, and the requirements of the International Building Code.
 - 1. Component Importance Factor is 1.0.
- D. Delegated Design:
 - 1. All stairs shall be engineered by the fabricator, following the design, configuration, component types and general sizes given on the drawings, and as specified herein. Any member that requires a change in size to meet engineering or code requirements shall be brought to the attention of the Engineer prior to fabrication. Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.04 ACTION SUBMITTALS

- A. Product Data: For metal stairs and the following:
 - 1. Precast concrete treads.
 - 2. Grating for treads and landings.
 - 3. Primers.
 - 4. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Provide stamped shop drawings and stamped calculations by a licensed Professional Engineer in the State of Washington. See Structural General Notes for additional information. See Architectural and Structural Drawings for additional requirements such as minimum stringer type/sizes, etc.
- C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for the preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Primer Standards:
 - 1. Provide surface preparation method.
 - 2. Provide primer type.
 - 3. Provide the primer manufacturer's printed instructions or standards on surface preparation of exposed aged primer prior to intermediate and finish coats.
 - 4. Provide primer manufacturer's printed information recommending compatible intermediate and finish coats.
- B. Primer and Top Coat Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.07 COORDINATION

- A. Coordinate shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to warrant that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of columns and posts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed).
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- D. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

2.03 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- E. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- F. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.04 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Primer Type: Mio/Zinc single component moisture cure. TNEMEC Series 394-250 PerimePrime or equivalent. Mio/Zinc primer suitable for the following:
 - 1. Application over SP-3 Power Tool Cleaning.
 - 2. Class B coating for slip-critical faying connections.
 - 3. VOC compliant.
 - 4. Compatible with acrylic and two component finish systems.

2.05 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a uniform radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.06 STEEL-FRAMED STAIRS

- A. Stair Framing: Frame stairs as indicated below, and as indicated on the drawings, with the drawings taking precedence.
1. Fabricate stringers of steel as indicated on drawings.
 - a. Provide steel plate closures for exposed ends of stringers.
 2. Construct platforms of steel headers and miscellaneous framing members as needed to comply with performance requirements, and as indicated on drawings, with the drawings taking precedence.
 3. Weld stringers to headers; weld framing members to stringers and headers, and as indicated on drawings, with the drawings taking precedence.
 4. Where stairs are enclosed by gypsum board assemblies, provide posts or struts to support landings from floor construction below. Locate posts and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm), unless indicated otherwise on the drawings.
1. Steel Sheet: MioZinc primed cold or hot-rolled steel sheet, unless otherwise indicated on drawings.
 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 4. Shape metal pans to include nosing integral with riser.
- C. Interior Treads and Landings: Precast Concrete
- D. Exterior Treads and Landings: Aluminum Grating:
1. Single part bar abrasive stair tread and nosing
 - a. Manufacturer: NYSTROM, INC. product series "STSB," substitution per Instructions and section 00 26 00
 2. Base and Nosing
 - a. Extended Aluminum Type: 6063-T5

- b. Finish: Powder Coat. Provide manufacturer standard colors for selection by Engineer.
- 3. Tread Abrasive Filler
 - a. Width: 1.875"
 - b. Fastening: Extruded Anchors

2.07 STAIR RAILINGS

- A. Comply with applicable requirements in Division 05 Section "Pipe and Tube Railings."

2.08 FINISHES

- A. Comply with NAAMM's, SSPC Products for recommendations for applying and designating finishes.
- B. Comply with applicable requirements in Division 05 Section "Pipe and Tube Railings." Prime designated stair assemblies in accordance with this specification and the SSPC Vol I&II Good Painting Practices

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction. Provide all additional support structure (including any columns or footings required) for complete fabrication of the stair.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.02 INSTALLING RAILINGS

- A. Comply with applicable requirements in Division 05 Section "Pipe and Tube Railings."

3.03 ADJUSTING AND CLEANING

- A. Primer Spot Repair: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop Mio/Zinc Primer with same material as used for shop priming to comply with SSPC-PA 1 for repairing shop-primed surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.5-mil dry film thickness.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 05 51 00.01 – “Metal Stairs.”
 - 2. Section 06 10 00.01 – “Rough Carpentry” for wood blocking for anchoring railings.

1.02 SUMMARY

- A. Section Includes:
 - 1. All railings (guardrails, handrails and other railings) for the entire project, including railings to be installed under other Sections.
 - 2. Gates and gate hardware associated with railings.
 - 3. Stainless Steel Cable Railing System.

1.03 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.04 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.05 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Cable Railing Systems: Manufacturer shall have a minimum of five years' experience in producing cable assemblies of the type specified.

1.08 PROJECT CONDITIONS

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

1.09 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with primer, paint and coating manufacturers' written recommendations to warrant that shop primers and topcoats are compatible with one another. Provide certification of surface preparation of primer prior top coat.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.02 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed).
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide High Performance Coating finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.03 RAILING CABLE SYSTEMS

- A. Manufacturers: Provide Stainless Steel Cable railing system from the following approved manufacturers.
 - 1. FEENEY WIRE ROPE & RIGGING (2603 Union Street Oakland, CA 94607, (800) 888-2418.
 - a. Product: CableRail[®] cable assemblies and fittings.
 - b. Or approved substitute per Instructions to Bidders and Section 00 26 00
- B. Materials: Provide materials as specified below:
 - 1. Cables: Type 316 Stainless Steel with polished finish, commercial, dry grade.
 - a. Standard 1/8" Assembly: 1/8" diameter by length as required, 1X19 construction, Type 316 Stainless Steel Cable with a Stainless Steel threaded terminal factory attached to one end.

b. Provide all other accessories as required by manufacturer for complete installation.

2. Fittings: Swage Style: Type 316 Stainless Steel, vibratory/tumbled finish.

2.04 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Primer Type: MioZinc single component moisture cure. TNEMEC Series 394-250 PerimePrime or equivalent. Mio/Zinc primer suitable for the following:

1. Application over SP-3 Power Tool Cleaning.

2. Class B coating for slip-critical faying connections.

3. VOC compliant.

4. Compatible with acrylic and two component finish systems.

C. Non-shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, non-shrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble railings in the shop to 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. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
 - 1. As detailed.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with welded end caps.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

- P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- Q. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.07 FINISHES, ALUMINUM AND NON FERROUS METALS

- A. Comply with NAAMM's and SSPC for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.08 STEEL AND IRON FINISHES

- A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves.
- B. Prepare in accordance with SSPC-SP 6, "Commercial Blast Cleaning."
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC Vol I&II Good Painting Practice.
 - 1. Shop prime railings. Type: MioZinc single component moisture cure. TNEMEC Series 394-250 PerimePrime or equivalent. Mio/Zinc primer suitable for the following:
 - a. Application over SP-3 Power Tool Cleaning.
 - b. Class B coating for slip-critical connections.
 - c. VOC compliant.
 - d. Compatible with acrylic and two component finish systems.
 - 2. Do not apply primer to galvanized surfaces except for spot repairs.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, prime with a 3ml DFT epoxy.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.04 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.05 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends, unless detailed otherwise.

- B. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.06 RAILING CABLE SYSTEMS

- A. Examine all conditions for anchoring prior to installation. Verify post size and cable spacing are in accordance with manufacturer's recommendations.
- B. Take field measurements and compare installation conditions to shop drawings. Notify manufacturer if field measurements vary from shop drawings.
- C. Follow manufacturer's installation instructions.
- D. Clean cables thoroughly using synthetic scotch-type pads and hot soapy water to remove residual lubricants. Rinse thoroughly with clear water and wipe dry.

3.07 ADJUSTING AND CLEANING

- A. Repair Primer: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop MioZinc Primer with same material as used for shop painting to comply with SSPC Vol. I&II Good Painting Practice for repairing shop-primed surfaces.
- B. Apply by brush or spray to provide a minimum 2.5-mil dry film thickness.

3.08 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

1. Section 06 16 00.01 – “Sheathing.”

1.02 SUMMARY

- A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Wood stud framing.
3. Plywood backing panels.

1.03 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NLGA: National Lumber Grades Authority.
 2. WCLIB: West Coast Lumber Inspection Bureau.
 3. WWPA: Western Wood Products Association.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Shop Drawings: Include large-scale details of connections and all headers and their supports. See Structural Notes for additional requirements for shop drawings.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineer's and Ports, and other information specified.

1.05 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Power-driven fasteners.
 - 3. Powder-actuated fasteners.
 - 4. Expansion anchors.
 - 5. Metal framing anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal (38-mm actual) thickness or less, no limit for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC 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 and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade, unless indicated otherwise on the Structural Drawings.
 - 1. Application: Interior partitions not indicated as load-bearing.
 - 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- B. Load-Bearing Partitions: Construction or No. 2 grade, unless indicated otherwise on the Structural Drawings.
 - 1. Application: Exterior walls and interior load-bearing partitions.
 - 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- C. Ceiling Joists: Construction or No. 2 grade, unless indicated otherwise on the Structural Drawings.
 - 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- D. Joists, Rafters, and Other Framing Not Listed Above: Construction or No. 2 grade, unless indicated otherwise on the Structural Drawings.
 - 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- E. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Application: Exposed exterior framing at roof overhangs.
2. Species and Grade: As indicated above for Joists and Rafters, unless indicated otherwise on the Structural Drawings.

2.04 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction:
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
 1. Hem-fir; WCLIB, or WWP.
 2. Douglas fir-larch; WCLIB or WWP.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 1. Hem-fir; WCLIB, or WWP.
 2. Douglas fir-larch; WCLIB or WWP.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete

as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.07 METAL FRAMING ANCHORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Phoenix Metal Products, Inc.
 2. Simpson Strong-Tie Co., Inc.
 3. USP Structural Connectors.
 4. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 1. Use for interior locations unless otherwise indicated.

2.08 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- 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, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and needed, and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
- J. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- K. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- M. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 WOOD BLOCKING INSTALLATION

- A. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.03 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

3.04 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, unless indicated otherwise on structural or architectural drawings. Fasten plates to supporting construction unless otherwise indicated.
 - 1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
 - 2. Frame walls with stud size and spacing as indicated on the architectural and structural drawings. If a conflict exists between the architectural and structural drawings, assume the wall will be framed with the larger member and closer spacing for bidding purposes, and send the Engineer an RFI requesting clarification.
- B. Construct corners and intersections with three or more studs, unless indicated otherwise on the Structural Drawings.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For walls, provide double-jamb studs for openings 60 inches (1500 mm) and less in width, and triple-jamb studs for wider openings, unless indicated otherwise.
 - 2. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.

3. For exterior non-load bearing walls, provide jamb studs and headers as indicated on structural drawings.
4. Load-bearing walls, not used.

D. Provide bracing at exterior non-load-bearing walls as indicated on the Structural Drawings.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Port will engage a qualified independent testing and inspecting agency to inspect drag struts, hold-downs, roof diaphragms, and shear walls
- B. Connections: Verify proper nailing, bolting and anchorage of wood components that are part of drag struts, and holdowns.
- C. Roof diaphragms and shear walls: Verify proper nailing.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 06 10 00.01 – “Rough Carpentry” for plywood backing panels.
 - 2. Section 07 25 00.01 – “Weather Barriers” for water-resistive barrier applied over wall sheathing.
 - 3. Section 07 54 00.01 Polyvinyl-Chloride (PVC) roofing for gypsum sheathing as part of the roofing system.

1.02 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.04 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit waterproof underlayment work to be performed according to manufacturer's written instructions and warranty requirements.

PART 2 - PRODUCTS

2.01 WALL SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I Sheathing.
- B. Oriented-Strand-Board Wall Sheathing: Not allowed.
- C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

2.02 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M, unless indicated otherwise on the structural drawings.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

2.03 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall Sheathing:
 - a. Nail to wood framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing.
 - 2. Applications include, but are not limited to the following surfaces:
 - a. Exterior, below-grade surfaces of concrete foundation walls, recessed pit wall, and associated footings.

1.03 ACTION SUBMITTALS

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

1.04 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

2.02 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. KARNAK CORPORATION; Number 220AF.
 - 2. SONNEBORN: Hydrocice 700B.
 - 3. Or approved substitute during the bid process per Instructions to Bidders and section 00 26 00.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1.
- C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.03 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing earth face of retaining walls, lap dampproofing at least 1 inch onto flashing (if any), unless detailed otherwise.
- D. Where dampproofing interior face of above-grade, exterior concrete and masonry, and single-wythe masonry walls, continue dampproofing through intersecting walls by keeping

vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.04 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).
- B. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.05 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 30 00.01 – “Cast-in-Place Concrete” for coordination with concrete foundation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Self-adhesive, rubberized asphalt/polyethylene waterproofing membranes for below-grade vertical surfaces. For use at elevator pit.
 - 2. Pre-applied waterproofing membranes under poured concrete slabs. For use at elevator pit.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For each exposed product and for each color and texture specified, including the following products:
 - 1. 8-by-8-inch (200-by-200-mm) square of waterproofing and flashing sheet.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: Manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.02 SELF-ADHESIVE, RUBBERIZED ASPHALT/POLYETHYLENE WATERPROOFING

A. Modified Sheet Waterproofing Membrane:

1. Products

<<http://www.specagent.com/LookUp/?ulid=1608&mf=04&mf=95&src=wd&mf=&src=wd>>:
Provide the following:

a. BITUTHENE 3000 as manufactured by Grace Products

b. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.

2. Physical Properties:

a. Color: Dark gray-black

b. Minimum 1/16 in (1.5mm) nominal thickness.

c. Tensile Strength, Membrane: 325 psi (2240 KPa) minimum; ASTM D 412, Die C, modified.

d. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.

e. Low-Temperature Flexibility: Pass at minus 25 degree F (minus 32 degrees C); ASTM D 1970.

f. Crack Cycling: At minus 25 degree F (minus 32 degrees C), unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.

g. Puncture Resistance: 50 lbf (222 N) minimum; ASTM E 154.

h. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.

i. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.

j. Location: Elevator Pit

2.03 PRE-APPLIED BELOW SLAB WATERPROOFING MEMBRANE

A. HDPE Waterproofing:

1. Products : Provide the following:
 - a. PREPRUFE 300R as manufactured by Grace Products
 - b. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
2. Physical Properties:
 - a. Color: White
 - b. Minimum 0.046 in (1.2mm) nominal thickness.
 - c. Tensile Strength, Membrane: 4000 psi (27.6 MPa) minimum; ASTM D 412, Die C, modified.
 - d. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - e. Low-Temperature Flexibility: Pass at minus 10 degree F (minus 23 degrees C); ASTM D 1970.
 - f. Crack Cycling: At minus 10 degree F (minus 23 degrees C), unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
 - g. Puncture Resistance: 221 lbf (990 N) minimum; ASTM E 154.
 - h. Peel Adhesion to Concrete: 5.0 lbs/in (880 N/m) width
 - i. Lap Peel Adhesion: 2.5 lbs/in (440 N/m) width
 - j. Permeance to water vapor transmission: Maximum 0.5%
 - k. Water Absorption: 0.5 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
 - l. Water Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
 - m. Methane Permeability: 9.1 mls/msq/day
 - n. Permeability (Hydraulic Conductivity) $K=1.4 \times 10^{-11}$ cm.S-1
 - o. Location: Elevator Pit

2.04 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258. Do not apply any primer to membrane.
- F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.03 SELF-ADHESIVE, RUBBERIZED SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- E. Seal edges of sheet-waterproofing terminations with manufacture's recommended joint fillers and sealants. Allow joint and lap sealants to fully cure.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- G. Immediately install protection course with butted joints over waterproofing membrane.

3.04 PRE-APPLIED WATERPROOFING MEMBRANE

- A. Install membrane sheets according to waterproofing manufacturer's written instructions and recommendations.
- B. Repair tears, voids, and lapped seams in waterproofing in compliance with manufacturer's written instructions.

3.05 FIELD QUALITY CONTROL

- A. Port may engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Engineer.

3.06 PROTECTION, REPAIR, AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 07 54 19.01 – "Polyvinyl Chloride (PVC) Roofing" for insulation installed as part of a complete roofing system.
 - 2. Division 05 and 06 Sections for installation in steel and wood-framed assemblies of insulation specified by referencing this Section.
 - 3. Division 23 sections for duct and pipe insulation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Foam-plastic board insulation (rigid insulation).
 - 2. Spray Foam Insulation
 - 3. Glass-fiber blanket insulation.
 - 4. Mineral-wool ("Rockwool") blanket insulation.
 - 5. Vapor Retarder (at wood framed wall conditions)

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.05 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Source Limitation: Obtain each type of building insulation through one source from a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation (Noted as EPS and/or rigid insulation on Drawings): ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - d. Pactiv Building Products.
 - e. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.

2.02 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Knauf Insulation.
 5. Owens Corning.
 6. Roxul, Inc.
 7. Thermafizer, Inc.
 8. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 1. Mineral-Fiber Type: Provide as specified in this paragraph, except provide from slag or rock wool where required by code.
 2. Stud cavity size: For 3 ½ and 4 inch stud walls, provide R-13 as indicated below. For 6 inch and larger stud walls, provide R-19 as indicated below.
 3. Other Thicknesses: As indicated on Drawings. May require two or more layers.
 4. Locations for Use:
 - a. Code Required: Provide where required by Code.
 - b. Hollow Metal Door and Relite Frames: Provide for all hollow metal jambs and heads, and for all relite heads, jambs, and sills.

- C. Unfaced Mineral Fiber Blanket/Batt Sound Insulation: Sound insulation produced by combining mineral fibers of type described below – with thermosetting resins to comply with ASTM C665 for Type I blankets without membrane facing; and as follows:
1. Mineral Fiber Type (“Rockwool”): Fibers manufacturer from glass.
 2. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 respectively.
 3. Sizes: Widths as required to fit stud or joist spacing as indicated on drawings. Thickness shall be as follows:
 - a. 3 ½ inch thick for 3 ½ and 4 inch stud walls, and where indicated.
 - b. 6 inch thick for 6 inch and larger stud walls, and where indicated.
 4. Furnish same insulation cut in strips for filling space between wall studs and door and relight frames in all sound –retardant wall, whether shown on drawings or not.
 5. Furnish sound attenuation fire blankets in rated assemblies as required to meet specific assemblies listed.

2.03 SPRAY-FOAM INSULATION

- A. Type: Injection foam, closed-cell, polyurethane insulation, with non-Chlorofluorocarbon (Non-CFC) blowing agent.
- B. Manufacturers: FOAM-TECH “SUPERGREEN FOAM”, a division of Building Envelope Solutions, Inc, 802-333-4333, or approved substitute during the bid process per Instructions to Bidders.
1. No added urea-formaldehyde.
- C. Thermal Performance:
1. R-Value: Minimum R-6 per inch.

2.04 VAPOR RETARDER

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Basis-of-Design Product: CETAINTeed (SAINT-GLOBAIN); “MemBrain” vapor barrier.
 2. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Technical Requirements:
1. Applicable Standards and Codes: Complies with ICC, CCMC 13278-R, and CAN/ULC-S102.
 2. Material Standards: Complies with ASTM C 665 Section 7.4, Water-Vapor Permeance, and ASTM E 96.
 3. Fire Resistance: Complies with ASTM e 84 surface burning characteristics; Maximum flame spread index of 20, and Maximum smoke developed index of 55.
 4. Water Vapor Permeance: Less than or equal to 1.0 perm, ASTM E 96, Desiccant method.
 5. Fungi Resistance: No growth under ASTM C 1338.
 6. Corrosivity: ASTM C 665, no unusual aspect of corrosion such as pitting, cracking and adhesive cure inhibition.

- C. Locations for Use: For general use at all roof truss locations with batt/blanket insulation, and at exterior walls where spray foam insulation is NOT used, and except where other types of vapor retarders are specified herein or where another type is required to meet code.
- D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- E. Vapor-Retarder Fasteners: As recommended by the vapor-retarder manufacturer.
- F. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- G. Fasteners and Other Insulation Retainage Systems: Provide as indicated on the drawings, or as otherwise required to provide a complete and proper insulation system, and as recommended by the insulation manufacturer for the application of each insulation type.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Comply with Washington State Non-Residential Energy Code for Building Envelope Sealing.
- C. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- D. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF SPRAY-FOAM INSULATION

- A. Install spray-foam insulation complying with manufacturer's written instructions. Install at all locations shown on drawings and all location in exterior envelope where primary envelope insulation system does not fill all voids and gaps, including but not limited to jambs and heads at wall openings, exterior side of wide flange beams, etc. Install in lieu of other types of insulation materials if the construction schedule does not allow for the prevention of water or moisture damage of the originally specified insulation material.

3.04 PROTECTION

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

END OF SECTION

PART 1 – GENERAL

1.01 SUMMARY

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 05 12 00.01 – “Structural Steel Framing”
 - 2. Section 05 31 00.01 – “Steel Decking”
 - 3. Section 06 10 00.01 – “Rough Carpentry”

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. American National Standard Institute (ANSI)
 - 1. ANSI Z359.1-2007 – Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
 - 2. ANSI Z359.6-2009 – Specifications and Design Requirements for Active Fall Protection Systems
- C. Occupational Health And Safety Administration (OSHA)
 - 1. OSHA 1926.502 – Fall Prevention Systems Criteria and Practices

1.03 SYSTEM DESCRIPTION

- A. General: Provide structural fall restraint and fall arrest system capable of withstanding loads and stresses within limits and under conditions specified in OSHA and other applicable safety codes. Provide fall protection anchors permanently attached to roof structure.
- B. Design Requirements: Anchors and accessories comprising system of following types:
 - 1. Guardian CB Anchors, spaced as indicated by manufacturer, for safety snap connection by individual workers capable of withstanding a 5,000 pound load or safety factor of 2 meeting the requirements of OSHA 1926.502(d)(8).
- C. Performance Requirements: System and components tested for the resistance of the following loads:
 - 1. Fall Restraint: 1 User
 - 2. Fall Arrest: 1 User
 - 3. Design fall protection anchors to resist a 5,000 pound load applied in any direction at maximum anchor height or provide engineered system designed meeting the requirements of OSHA 1926.502(d)(8).

1.04 SUBMITTALS

- A. Product Data: For each type of device specified, including manufacturer’s standard fabrication details and installation instructions.
- B. Shop Drawings: Show layout, profiles, and anchorage details. Shop drawings & calculations to be stamped by a Professional Engineer registered in the State in which the project is located.
- C. Maintenance Data: Written instructions for maintenance of fall prevention safety devices to be included in the operation and maintenance manual.

- D. In-house Test Reports: Indicate anchor fabrication compliance with performance requirements.
- E. Signage: Provide laminated sign showing system layout and usage notes, to be installed at roof access locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm having at least 10 years continuous experience in manufacturing fall safety equipment similar to systems specified and exhibiting records of successful in-service acceptability and performance. Firm must employ personnel dedicated to provide regularly scheduled Authorized and Competent Person Training courses as mandated by OSHA 1926 and 1910 for Port's authorized safety personnel.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of roof anchors that are similar to those indicated for this Project in material, design and extent.
- C. OSHA Standards: Comply with Occupational Safety and Health Administration Standards for the Construction Industry 29 CFR § 1926.500 Subpart M (Fall Protection), and with applicable State Administrative Code safety standards for Fall Restraint and Fall Arrest.
- D. Source: Provide laminated sign showing system layout and usage notes, to be installed at roof access locations.
- E. Testing: Perform quality control tests for each system per manufacturer's requirements.

1.06 COORDINATION

- A. Contractor to coordinate installation of structural deck to meet requirements of roof anchor manufacturer.
 - 1. Metal Deck: Minimum 18 gauge thickness, or provided with additional deck reinforcing per manufacturer's instructions.
 - 2. Structural beam for weld-on or backer plate connection: structure must be capable of supporting a 5,000 pound ultimate load.
 - 3. Other structural decks not listed above shall be approved by a Qualified Person.
- B. Contractor to coordinate installation of structural deck reinforcements and anchorages to receive fall protection anchors.
- C. Contractor to coordinate placement of roofing system, insulation and flashing to ensure water-tight integrity to roof.

1.07 WARRANTY

- A. Provide manufacturer's standard warranty to guarantee products will be free from defects for a period of 12 months. Warranty period shall become effective on date of substantial completion.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Provide fall protection system manufactured by GUARDIAN FALL PROTECTION INC., 6305 South 231st Street Kent, WA, phone 800-466-6385, fax 800-670-7892, or equal.

2.02 MATERIALS

- A. CB Anchor post: 2-1/2" schedule 80 pipe, (size as necessary for height).

B. CB Anchor U-bar: 5/8" diameter U-bar

C. CB Anchor base plate

2.03 PRIMING AND FINISHING

A. Priming: Prime as required in Division 05, Section "Metal Fabrications".

B. Finish: Finish as required in Division 09, Section "High Performance Coatings". Apply primer and HPC coating in shop prior to shipping to site.

2.04 MANUFACTURED ASSEMBLIES

A. GUARDIAN CB-12 or CB-18 Roof Anchors.

2.05 FABRICATION

A. Fabricate work true to dimension, square, plumb, level, and free from distortions or defects detrimental to appearance and performance.

B. Prepare, treat and coat metal to comply with manufacturer's written instructions. Prepare metal by removing grease, dirt, oil, flux, and other foreign matter.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine framing and substrate and verify conditions comply with structural requirements for proper system performance.

B. Proceed with installation of roof anchors only after verifying conditions are satisfactory.

3.02 INSTALLATION

A. General: Installation of Anchor Posts to be performed by contractor according to manufacturer's instructions and recommendations.

3.03 FIELD QUALITY CONTROL

A. Testing: Test on site 100% of anchors relying upon chemical adhesive fasteners using load cell test apparatus in accordance with manufacturer's written recommendations.

3.04 ADJUSTMENT AND INSPECTION

A. Ensure all manufactured anchors have been installed in accordance with fall protection manufacturer's engineering documentation and specifications.

B. Provide plan drawings with any deviations in anchor locations as installed.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 06 16 00.01 – “Sheathing” for coordination with substrate that Weather Barriers are installed over.
 - 2. Division 08 Sections for coordination with openings.

1.02 SUMMARY

- A. Section Includes:
 - 1. Water-resistant barrier (WRBPS).
 - 2. Water-resistant barrier (WRB).
 - 3. Fluid-applied waterproofing (FAWP).
 - 4. Self-adhering membrane flashing (SAM).

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards, and substantiating compliance with building code in effect for Project.
 - 2. For flexible flashing and waterproof underlayment products.
- B. Provide proof of compatibility between flexible flashing products and sealants and between building wrap and other products.
- C. Shop Drawings:
 - 1. Provide full shop drawings (drawings and large scale details) illustrating the installation requirements and the relationship between the flexible flashing and / or building wrap and associates materials, such as waterproof underlayment and flashing, framing and blocking, insulation, sheathing, exterior wall finish systems, wall openings (windows, doors, louvers, etc.), flashings, wall penetrations, etc.
- D. Samples:
 - 1. Building Wrap: Three 8-1/2 x 11 inch samples of sheet, samples of tapes, wall opening specialties, and fasteners.
 - 2. Flexible Flashing and Waterproof Underlayment: Three 8-1/2 x 11 inch samples of each sheet, of each type of underlayment and flashing specified.
- E. Installation Instructions: Provide manufacturer's printed installation instruction for each product specified in this Section.

1.04 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive and weather-resistive barrier and flexible flashing, from ICC-ES.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain all materials for each product type from one source or producer.
- B. Mockups: Build mockup of wall assembly and sample opening including each wall component specified in this section to illustrate specified installation procedures, requirements, and quality of workmanship. Mock-ups shall remain available for review throughout construction period.
- C. Preinstallation Conference: Conduct conference at Project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Stack sheathing flat on leveled supports off the ground, under cover, and fully protected from weather.
- B. Store rolls of building wrap and waterproof underlayment under cover, on a clean, level surface, either flat or upright.

PART 2 - PRODUCTS

2.01 WATER-RESISTIVE / WEATHER-RESISTIVE BARRIER / AIR BARRIER (WRB AND WRBPS)

- A. Building Wrap (WRB / WRBPS AKA Weather-Resistant or Water-Resistant Barrier): ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Manufacturer/Product: VAPROSHIELD INC. (866-731-7663) www.VaproShield.com "WrapShield", or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
 - 2. Material: Spun Bonded Polypropylene underlayment, in 59 inch rolls.
 - 3. Other Standards: The product shall meet or exceed all of the manufacturer's standards for the Basis-of-Design product, as if printed herein.
 - 4. Accessories / Auxiliary Materials and Products: Provide underlayment flashing rolls, factory formed corners, small penetration flashing, single-sided taped, double-sided tape, air barrier joint sealant, and other accessories as recommended by the system manufacturer for a complete and proper system.
 - 5. Fasteners: Provide vaprocaps with #6, #7 or #8 size corrosion resistant bugle head self-tapping screws of the appropriate thread design and length for attachment to metal furring, as recommended by the weather-resistant barrier manufacturer for the substrate and structure being specified for this project.
 - 6. Locations of Use: At all locations where Building Wrap is indicated, unless specifically noted as another product.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.02 FLEXIBLE FLASHING (FAWP)

- A. Flexible Flashing (FAWP Fluid-Applied Water Proofing) Water proof, single component, flexible reinforced fill-coat, seam and joint treatments.
 - 1. Locations: For use in conjunction with building wrap at all wall openings, such as doors, windows, louvers, other penetrations, and as detailed. Also for use around all masonry veneer anchors penetrating the Building Wrap.

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. BUILDING ENVELOPE INNOVATIONS (BEI), www.wet-flash.com, 503-972-5452; Penetration Membrane 7000 for Flashing Membrane and Fiber Reinforced FR-7200 for Seam Filler.
 - b. VAPRO SHIELD www.vaproshield.com
 - c. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
3. Standards: Must meet or exceed all test standards of referenced manufacturer's product.

2.03 SELF-ADHERED MEMBRANE FLASHING (SAM)

- A. General: Provide product that is compatible with, and will fully adhere to the Building Wrap.
 1. Product:
 - a. Self-Adhering, High-Temperature Sheet: 40 mils (1.0 mm) thick minimum, consisting of cross-laminated polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1) Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 - 2) Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 - 3) Products: GRACE, W. R. & CO.; Vycor Ultra, or Henry Blueskin PE200 HT (40 mil), or Carlisle CCW 300Htor 403HR, or approved substitute per Instructions to Bidders and section 00 26 00.
 - 4) Locations of Use: Used in conjunction with the Building Wrap at locations shown on the drawings, except where Flexible Flashing (Fluid Applied Flashing) is used.

2.04 MISCELLANEOUS MATERIALS

- A. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing and waterproof underlayment for substrate(s).
- B. Nails and Staples: ASTM F 1667.
- C. Mechanical Fasteners: Stainless steel or galvanized steel of the type and size recommended by the building wrap manufacturer for attachment of building wrap to stud framing or backing.

PART 3 - EXECUTION

3.01 WATER / WEATHER-RESISTIVE / AIR BARRIER INSTALLATION

- A. Surface Preparation: Clean and prepare substrate according to the weather-resistant barrier manufacturer's written recommendations. Provide a clean and dry substrate for product application.
- B. Manufacturer's Instruction: Install weather-resistant barrier strictly following the manufacturer's printed instructions. In case of any conflict between the manufacturer's printed instructions and the field conditions, drawings or specifications, contact the Engineer for clarification prior to commencement of work. Any work undertaken without such clarification will be at the Contractor's cost and risk.
 1. Seal seams, edges, fasteners, and penetrations with tape.

2. Terminate and seal at openings as detailed.
 3. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.
- C. Cover exposed exterior surface of sheathing with water/weather-resistive barrier securely fastened to framing immediately after sheathing is installed.
- D. Penetrations: Install product as detailed, and as recommended by the manufacturer.
- E. Barrier Installation: Install membrane in accordance with manufacturer's written instructions over wall sheathing, and at soffits and other locations indicated. Mechanically fasten the membrane so that the subsurface is protected from weather until exterior finish systems can be installed. Seal against all openings and terminations. Vertical laps shall be a minimum of 6 inches with taped joints, and horizontal laps shall be lapped 6 inches minimum shingled to direct water away from wall.

3.02 FLEXIBLE FLASHING AND SEAM FILLER INSTALLATION

- A. General: Install flexible flashing and seam filler as indicated herein and as shown on drawings. Follow manufacturer's printed installation recommendations. Apply primer if required by manufacturer. Comply with temperature restrictions of manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures.
- B. Apply flexible flashing and seam filler where indicated to comply with manufacturer's written instructions.
1. Prime substrates as recommended by manufacturer.
 2. Lap seams and junctures with other materials except at flashing flanges of other construction.
 3. Lap flashing over water/weather-resistive barrier at bottom and sides of openings.
 4. Lap water/weather-resistive barrier over flashing at heads of openings.
 5. Install seam filler at all locations indicated on the drawings and where recommended by the manufacturer for a complete and weather tight installation.

3.03 SELF-ADHERED MEMBRANE FLASHING

- A. Installation: Install self-adhered membrane flashing and all accessories, wrinkle free, on WRB and at other locations shown on the drawings, following the manufacturer's written installation instructions. Install in conjunction with other products to provide a weathertight envelope system. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply where indicated on drawings, with end laps as recommended by the manufacturer, and as indicated on the drawings. Roll laps with roller. Cover underlayment within 14 days, unless otherwise approved by Engineer.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: In addition to manufacturer's testing and inspection, Port may engage a qualified independent testing and inspecting company / consultant to perform inspections and prepare reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed installation of water/weather-resistant barrier and flexible flashing, including accessories. Report results in writing.

- C. Remove and replace applications of where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction until materials are covered by other construction assemblies.
- B. Replace materials that have been damaged or have deteriorated.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 06 10 00.01 – “Rough Carpentry” for support framing, including furring, studs, and bracing and for blocking needed for wall panels.
 - 2. Section 06 16 00.01 – “Sheathing” for wood panel sheathing substrate for metal wall panels.
 - 3. Section 07 21 00.01 – “Thermal Insulation” for rigid insulation installed as part of complete wall system.
 - 4. Section 07 25 00.01 – “Weather Barriers” for weather barrier materials installed under metal wall panels as part of a complete weather envelope wall system.
 - 5. Section 07 62 00.01 – “Sheet Metal Flashing and Trim” for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.02 SUMMARY

- A. Section Includes:
 - 1. Concealed-fastener, lap-seam metal wall panels
 - 2. Exposed-Fastener Metal Panels.
 - 3. Metal soffit panels.
 - 4. Trim Accessories

1.03 DEFINITION

- A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward.

- b. Uniform pressure as indicated on Drawings.
- 2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.05 ACTION SUBMITTALS

- A. General: Coordinate submittals for metal roofing, metal soffits, metal siding, and metal flashing.
- B. Product Data: For each type of product indicated. Include general product information, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.
- C. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
 - a. Flashing and trim.
 - b. Anchorage systems.
- D. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
 - 2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Wall and Soffit Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
 - 2. Trim and Closures: 12 inches (305 mm) long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch- (305-mm-) long Samples for each type of accessory.

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:
 - 1. Wall panels and attachments.
 - 2. Stud framing.

3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.
- B. Qualification Data: For Installer and professional engineer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- D. Field quality-control reports by the manufacturer's representative.
- E. Warranties: Sample of special warranties.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal wall panels to include in maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockup of typical wall panel profiles, inside and outside corner transitions, openings, soffit, transition and base flashing for each type of wall panel as shown on Drawings; approximately 4 by 4 foot by full thickness, including insulation, supports, attachments, and accessories.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
- D. Preinstallation Conference: Conduct conference at Project site.
 1. Meet with Engineer, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels, including installers of doors, windows, and louvers.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 7. Review temporary protection requirements for metal wall panel assembly during and after installation.
 8. Review wall panel observation and repair procedures after metal wall panel installation.

9. Review special wall panel seam alignments and other design features.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.
- B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, studs, backing in walls, furring, soffits, and other adjoining work to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: Thirty (30) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
 2. Surface: Smooth, flat finish.
 3. Exposed Coil-Coated Finish:
 - a. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Panel Sealants:
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.02 MISCELLANEOUS METAL FRAMING

- A. Provided under Division 06 Section, "Rough Carpentry". Coordinate requirements of metal wall panels with framing provided under that section.

2.03 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.04 MP-1 HORIZONTAL METAL PANEL – EXPOSED-FASTENER

- A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping panels and mechanically attaching through panel to supports using exposed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
 1. Basis of Design Product: AEP SPAN, "Mini V-Beam" or a comparable product from a substitute manufacturer provided they can meet the requirements of these specifications including the special warranty. All substitution requests will be considered during the bid process per Instructions to Bidders. To be considered for approval, the manufacturer

must have a panel that is equivalent in every respect, including, but not limited to, design, appearance, color availability, structural performance, weathertightness, warranty availability, and all other aspects of this specification section.

- a. McElroy Metal, Inc. Approved subject to meeting all specification requirements.
 - b. Metal Sales Manufacturing. Approved subject to meeting all specification requirements.
 - c. Architectural Solutions. Approved subject to meeting all specification requirements.
 - d. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.
2. Material: Aluminum-zinc alloy-coated steel sheet, 22 gauge panel thickness.
 3. Exterior Finish: 2-coat fluoropolymer.
 - a. Color: As indicated on Color Schedule on the drawings. The Engineer also reserves the right to change the color indicated on the drawings and select another color from the manufacturer's full range of available colors at no additional charge.
 4. Clips: Floating to accommodate thermal movement.
 - a. Material: zinc-coated (galvanized) steel sheet, thickness as recommended by the panel manufacturer.
 5. Panel Coverage: 32 inches.
 6. Panel Height: 1 3/8 inches.
 7. Panel Form: Ribbed
 8. Reveal: None

2.05 MP-2 FLUSH METAL WALL PANELS- CONCEALED-FASTENER METAL WALL PANELS (VERTICAL)

- A. Vertical Metal Wall Panels: Concealed-Fastener flush metal wall panel wall system. Includes all accessories for weathertight installation.
 1. Basis of Design Product: AEP SPAN, "PRESTIGE, PS-12", or a comparable product from a substitute manufacturer provided they can meet the requirements of these specifications including the special warranty. All substitution requests will be considered during the bid process per Instructions to Bidders. To be considered for approval, the manufacturer must have a panel that is equivalent in every respect, including, but not limited to, design, appearance, color availability, structural performance, weathertightness, warranty availability, and all other aspects of this specification section.
 - a. McElroy Metal, Inc. Approved subject to meeting all specification requirements.
 - b. Metal Sales Manufacturing. Approved subject to meeting all specification requirements.
 - c. Architectural Solutions. Approved subject to meeting all specification requirements.
 - d. Or approved substitute during the bid process per Instructions to Bidders and section 00 26 00.
 2. Material: Aluminum-zinc alloy-coated steel sheet, 22 gauge panel thickness.
 3. Exterior Finish: 2-coat fluoropolymer.

- a. Color: As indicated on Color Schedule on the drawings. The Engineer also reserves the right to change the color indicated on the drawings and select another color from the manufacturer's full range of available colors at no additional charge.
- 4. Clips: Floating to accommodate thermal movement.
 - a. Material: zinc-coated (galvanized) steel sheet, thickness as recommended by the panel manufacturer.
- 5. Panel Coverage: 12 inches.
- 6. Panel Height: 1 1/2 inches.
- 7. Panel Form: Flush
- 8. Reveal: None

2.06 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and flat pan between panel edges; with flush joint between panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide AEP Span; "PRESTIGE (R-0) – 12 inch", or comparable product by one of the following:
 - a. McElroy Metal, Inc. Approved subject to meeting all specification requirements.
 - b. Metal Sales Manufacturing Corporation. Approved subject to meeting all specification requirements.
 - c. Garland. Approved subject to meeting all specification requirements.
 - d. Architectural Metal Solutions. Approved subject to meeting all specification requirements.
 - e. Or approved substitute during the bid process per Instructions to Bidders and section 00 26 00.
 - 2. Material: Aluminum-zinc alloy-coated steel sheet, 24 gauge nominal thickness.
 - a. Exterior Finish: 2-coat fluoropolymer.
 - b. Color: As indicated on Color Schedule on the drawings. The Engineer also reserves the right to change the color indicated on the drawings and select another color from the manufacturer's full range of available colors at no additional charge.
 - 3. Panel Coverage: 12 inches.
 - 4. Panel Height: 1-1/2 inches.
 - 5. Type: Flat Pan
 - 6. Reveal: None

2.07 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants,

gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from gauge matching the metal wall panels, for wall panels, and gauge matching metal soffits, for soffit panels, (unless noted or specified otherwise), aluminum-zinc alloy-coated steel sheet in finish type and colors to match siding panels and soffit panels, as applicable, as indicated on the drawings. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.08 FABRICATION

- A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.
- E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.09 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.
 - 1. Examine wall framing to verify that girts, angles, channels, furring, studs, blocking, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - 3. Verify that weather-resistant barrier paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
 - 4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to framing or backing/blocking in wood stud walls, as applicable, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Commence metal wall panel installation and install minimum of 500 sq. ft. in presence of factory-authorized representative.
 - 2. Shim or otherwise plumb substrates receiving metal wall panels.

3. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
4. Install screw fasteners in predrilled holes.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal wall panel work proceeds.
7. Panel splices are not allowed unless indicated otherwise on the drawings. Fabricate panels full length of span for all conditions.
8. If panel splices are specifically allowed, locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition. Locate as shown on drawings.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
11. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
12. Ensure installation of blanket installation fully cavities between the metal siding and the masonry.

B. Fasteners:

1. Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
2. Fasteners must penetrate into stud framing or backing in wall (or steel 'Z' furring where applicable) at $\frac{1}{2}$ to $\frac{3}{4}$ inch. Coordinate placement of studs and backing.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

1. Coat back-side of wall panels with high-solid surface tolerant epoxy coating where wall panels will contact the treated wood, ferrous metal, copper, lead, or cementitious construction.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Clean all excess sealant from panel joints and edges to provide clean appearance.

3.03 METAL SOFFIT PANEL INSTALLATION

- A. In addition to complying with requirements of "Metal Wall Panel Installation, General" Article, install metal soffit panels to comply with the requirements of this article.
- B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
 1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.04 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test completed metal wall panel installation, including accessories.
- B. Testing: The Port may, at the Port's option, conduct independent water intrusion testing of the metal panel installation.
 - 1. Water Penetration: Test for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft. (300 Pa).
 - 2. Water-Spray Test: After completing the installation of 75-foot- (23-m-) by-2-story minimum area of metal wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area.
- C. Remove and replace metal wall panels where tests and inspections indicate that panels do not comply with specified requirements.
- D. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 FIELD CUTTING

- A. Field Cutting shall be neat, square, and true using tools as recommended by panel manufacturer. Touch cutting is prohibited where cut is exposed to final view.
- B. For openings 6" and larger in any direction: Shop fabricate and reinforce to maintain original load capacity.
- C. Where necessary to saw cut panels, debur all cut edges.

3.07 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.
- B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 07 62 00.01 – "Sheet Metal Flashing and Trim" for metal roof flashings and counter flashings.
 - 2. Section 07 72 00.01 – "Roof Accessories" for roof hatches or other components installed as part of the roofing system.
 - 3. Section 07 92 00.01 – "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.02 SUMMARY

- A. Section Includes:
 - 1. Fully adhered polyvinyl-chloride (PVC) roofing system indicated as low slope roofing, mechanically fastened at vertical applications.
 - 2. Cover Board
 - 3. Roof Insulation
 - 4. Vapor Retarder
 - 5. Substrate (Roof Sheathing)
- B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 05 31 00.01 "Steel Decking."

1.03 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.04 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
 - 1. Meet with Port Engineer, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
 1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 1. Sheet roofing, of color required.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is approved for roofing system as specified for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Mock-ups: Provide for all transitions of roofing membrane at parapets, through-wall scuppers, and other transitions.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Weathertightness Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. (See Part 3, Execution for minimum warranty language)
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
 - 2. Warranty Period: Twenty (20) years. See Section 01 77 00 for start date.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, and vapor retarders, for the following warranty period:
 - 1. Warranty Period: Two (2) years. See Section 01 77 00 for start date.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain components including roof insulation, fasteners and all accessories for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
 - 1. Corner Uplift Pressure: 135 PSF
 - 2. Perimeter Uplift Pressure: 90 PSF
 - 3. Field-of-Roof Uplift Pressure: 60 PSF
- D. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- E. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.03 PVC ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type II, Grade I, glass-fiber reinforced, felt backed.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sarnafil Inc; Sarnafil G410. EnergySmart Roof Membrane System
 - b. Carlisle SynTec Incorporated.
 - c. GAF Materials Corporation.
 - d. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.
 - 2. Thickness: 60 mils (1.5 mm), nominal
 - 3. Exposed Face Color - White
 - 4. Vertical Faces: Vertical applications shall be mechanically fastened.

2.04 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard water based adhesive.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.05 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work:
 - a. CertainTeed Corporation; GlasRoc Sheathing Type X.
 - b. Georgia-Pacific Corporation; Dens Deck
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. USG Corporation; Securock Glass Mat Roof Board.
 - e. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.

2.06 VAPOR RETARDER (INTERIM ROOFING)

- A. Self-Adhering-Sheet Vapor Retarder: Also noted as "Interim Roofing" on Drawings. ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- (1.0-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.
- B. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated.

2.07 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated, and to achieve all slopes and transitions as indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Firestone Building Products.
 - d. GAF Materials Corporation.
 - e. Hunter Panels.
 - f. Insulfoam LLC; a Carlisle company.
 - g. Johns Manville.

- h. Rmax, Inc.
 - i. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.
2. Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slopes achieving positive drainage configurations as indicated on drawings.
 - D. Perlite Board: As approved by roofing manufacture, provide perlite board in conjunction with rigid installation for achieving smooth transitions in slopes.
 - E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.08 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 5/8 inch (13 mm)] or as recommended by roofing manufacturer.
 - 1. Products: Subject to compliance, as recommended by roofing manufacturer, with requirements, provide one of the following available products that may be incorporated into the Work:
 - a. CertainTeed Corporation; GlasRoc Sheathing
 - b. Georgia-Pacific Corporation; Dens Deck
 - c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
 - d. Temple-Inland, Inc; GreenGlass Exterior Sheathing.
 - e. USG Corporation; Securock Glass Mat Roof Board.
 - f. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.
- E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."

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

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.03 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.04 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.05 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.06 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.

- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
 - 1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
 - 2. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 3. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 - 2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
 - 4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 - 5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
 2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- K. Install slip sheet as recommended by roofing manufacturer.

3.07 ADHERED ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
1. Install sheet according to ASTM D 5036.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.08 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.09 FIELD QUALITY CONTROL

- A. Testing: Provide inspection of substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components by roofing manufacturer and to furnish reports to Engineer.
 - 1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
- B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
 - 2. Flood each area for 48 hours.
 - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
- C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Engineer and Port.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____,
herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Port: **<Insert name of Port>**.
 - 2. Address: **<Insert address>**.
 - 3. Building Name/Type: **<Insert information>**.
 - 4. Address: **<Insert address>**.
 - 5. Area of Work: **<Insert information>**.
 - 6. Acceptance Date: _____.

7. Warranty Period: **<Insert time>**.
8. Expiration Date: _____.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Port or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding **<Insert mph (m/sec)>**;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Port.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Port or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Port allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Port engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Port in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Port shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Port from other remedies and resources lawfully available to Port in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Port or a subcontract with Port's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 05 50 00.01 – “Metal Fabrications” for galvanized steel gutter support brackets and galvanized steel pipe or tube down spouts. Gutter brackets to be installed under this Section.
 2. Section 06 10 00.01 – “Rough Carpentry” for wood nailers, curbs, and blocking.
 3. Section 07 42 13.01 – “Metal Wall Panels” for sheet metal flashing and trim integral with metal wall and shift panels.
 4. Section 07 54 19.01 – “Polyvinyl Chloride Roofing” for clad metal flashing installed as part of roofing system at vertical conditions.
 5. Section 07 72 00.01 – “Roof Accessories” for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
 6. Section 09 91 23.01 - “Painting” for application of coating to stainless steel roof crickets and flashing specified under this Section.

1.02 SUMMARY

- A. Section Includes:
1. Manufactured Products:
 - a. Underlayment materials
 - b. Related accessory materials.
 2. Formed Products:
 - a. Formed roof drainage sheet metal fabrications.
 - b. Formed low-slope roof sheet metal fabrications.
 - c. Formed wall sheet metal fabrications.
 - d. Formed equipment support flashing.
 - e. Related accessory materials.

1.03 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Fabricate and install copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
1. Wind Zone 2: For velocity pressures of 31 to 45 lbf/sq. ft. (1.48 to 2.15 kPa): 90-lbf/sq. ft. (4.31-kPa) perimeter uplift force, 120-lbf/sq. ft. (5.74-kPa) corner uplift force, and 45-lbf/sq. ft. (2.15-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.04 ACTION SUBMITTALS

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

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

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection. Samples shall be on actual metal chips, not printed colors applied to paper or card stock.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size sample.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator.

B. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

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

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Port Engineer, Port's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
 - 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
 - 6. Conference shall be coordinated and held at same time as preinstallation conference for roofing.

1.08 DELIVERY, STORAGE, AND HANDLING

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

1.09 WARRANTY

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

PART 2 - PRODUCTS

2.01 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
 - 1. Finish: 2D (dull, cold rolled).
 - 2. Surface: Smooth, flat.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
 - 2. Surface: Smooth, flat, and with manufacturer's standard clear acrylic coating on both sides where another finish is not specified.
 - 3. Exposed Coil-Coated Finish: Provide for all flashing except where specifically indicated to be a bare galvalume or zincalume finish, if any.
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 4. Color: Match color of metal wall and roof panels where applicable. See those Sections for colors. For other applications, color to be selected by Engineer from manufacturer's full range of available colors, or a custom color. Quantity of colors as indicated on Color Schedule on drawings.
 - a. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.02 UNDERLAYMENT MATERIALS

- A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Vycor Ultra.

c. Henry Company; Blueskin PE200 HT.

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.03 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 3. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
 - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.04 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Except at standing seam copings, and unless noted otherwise for specific types of flashings or copings, where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength. Do not use graphite pencils to mark metal surfaces.

2.05 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof, unless detailed otherwise. Fabricate from the following materials:
 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes, exterior flange trim, and built-in overflows, unless detailed otherwise. Fabricate from the following materials:
 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- C. Splash Pans: Fabricate from the following materials:
 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- D. Downspouts: Provided industrial series commercial aluminum downspouts as manufactured by Perimeter Systems a Division of Southern Aluminum Finishing Company Inc. 139 Chatham Street Sanford, NC 27330; 1-800-334-9823, or equal.
 1. Finish: Match adjacent metal siding color
- E. Wire strainers for Downspout inlets at Conductor Heads: Stainless steel (as indicated on drawings) wire strainers for conductor heads, size to match downspout size.

2.06 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 - 1. Coping Profile: As indicated on the drawings.
 - 2. Joint Style: At all sheet metal copings, fabricate and install with one-inch high standing seams following SMACNA recommendations. Provide with 45 degree end, tightly joined and full sealed with one-part urethane sealant between faying surfaces. Secure with continuous 22 gauge galvanized sheet metal cleats at exterior face, and domed-gasketed screws spaced 24 inches on center along the interior vertical face of coping centered on the height of the vertical leg. No expansion provisions are to be provided unless noted or detailed otherwise.
 - 3. Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.
- B. Base Flashing, Counter Flashing, Flashing Receivers, & Misc. Flashing not specifically identified herein: Fabricate from the following material:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.0276 inch (0.7 mm) thick.
- C. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch (0.48 mm) thick. Use where not exposed to view from ground.
 - 2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick. Use where exposed to view from ground.

2.07 WALL SHEET METAL FABRICATIONS

- A. Opening and Penetration Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings, unless detailed otherwise. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick, unless noted otherwise on the drawings.

2.08 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.02 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- C. Self-Adhering Sheet Underlayment: Where indicated on the drawings, install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.03 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - a. Space cleats not more than 12 inches (300) apart. Anchor each cleat with a minimum of two fasteners. Bend tabs over fasteners.
 - 3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of sheet metal flashing and trim is not permitted.
 - 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
 - 1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

- C. Expansion Provisions: Except at standing seam copings or where detailed otherwise, provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws, and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
 - 3. Flashing Lap Joints: At all lap joints in metal flashings, lap sheet metal a minimum of 4 inches, or more if recommend by SMACNA, or more if indicated on the drawings. Install at least two continuous beads of sealant in each lap joint within and fully concealed by the lap joint.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.04 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement compatible with roofing membrane.
- C. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 1. Anchor scupper closure trim flange to exterior wall and solder to scupper, unless detailed otherwise.

2. Loosely lock front edge of scupper with conductor head.
 3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- D. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch (25 mm) below scupper discharge.
- E. Downspouts:
1. Install downspouts as indicated on drawings, and as recommended by Manufacturer.
 2. Provide elbows at base of downspout to direct water away from building, unless indicated otherwise.
 3. Connect downspouts to underground drainage system indicated.

3.05 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
- B. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 16-inch (400-mm) centers.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing, unless indicated otherwise. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant, unless detailed otherwise.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.06 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings, unless detailed otherwise.
- C. At wall openings that interrupt metal thru-wall flashings, bend end of flashing up to form ½" high end dams at all jambs. At sheet metal flashing end dams, fully seal corners. At stainless steel flashing, continuously weld corners.

3.07 MISCELLANEOUS FLASHING INSTALLATION

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.08 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.09 CLEANING AND PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 05 50 00.01 – “Metal Fabrications” for metal vertical ladders, ships' ladders, stairs for access to roof hatches, and for wall mounted fall restraint brackets.
 - 2. Division 07 low-slope roofing Sections for roofing accessories not specified herein.
 - 3. Section 07 62 00.01 – “Sheet Metal Flashing and Trim” for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.02 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.

1.03 PERFORMANCE REQUIREMENTS

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

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.05 INFORMATIONAL SUBMITTALS

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

1.06 CLOSEOUT SUBMITTALS

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

1.07 COORDINATION

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

1.08 WARRANTY

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

PART 2 - PRODUCTS

2.01 METAL MATERIALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.
 - 1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil (0.005 mm).
 - 2. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- C. Steel Shapes: Provide as specified in Division 05 Section "Metal Fabrications" if required for assemblies specified herein.

2.02 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Dissimilar Materials Primer: High-solids surface tolerant epoxy equivalent to TNEMEC Series 135 ChemBuild.
- C. Underlayment:
 - 1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide non-removable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.03 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AES Industries, Inc.
 - b. Babcock-Davis.
 - c. Bilco Company (The).
 - d. Bristolite Skylights.
 - e. Custom Solution Roof and Metal Products.
 - f. Dur-Red Products.
 - g. Hi Pro International, Inc.
 - h. J. L. Industries, Inc.
 - i. Metallic Products Corp.
 - j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - k. Nystrom.
 - l. O'Keeffe's Inc.
 - m. Pate Company (The).
 - n. Precision Ladders, LLC.
 - o. Or approved substitute during the bid process per Instructions to Bidders and Section 00 26 00.
- B. Type and Size: Single-leaf lid, size as indicated on the drawings.
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

- D. Hatch Material: Aluminum-zinc alloy-coated steel sheet, 0.079 inch (2.01 mm) thick.
 - 1. Finish – Buildings 'A' and 'B': Two-coat fluoropolymer. Color as selected by Engineer from manufacturer's full range of available colors.
- E. Construction:
 - 1. Insulation: Glass-fiber or Polyisocyanurate board.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 - 3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 - 4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
 - 6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant, unless indicated otherwise on the drawings. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

2.04 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with high-solid

surface tolerant epoxy coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless-steel roof accessories with suitable coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level, unless detailed otherwise.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

D. Seal joints with butyl sealant as required by roof accessory manufacturer.

3.03 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Division 07 Sections for sealants used in conjunction with sheet metal flashing, wall and roof panels.
 - 2. Division 08 Sections for sealants used with aluminum framed opening systems.

1.02 SUMMARY

- A. Section Includes:
 - 1. Urethane joint sealants.
 - 2. Latex joint sealants.
 - 3. Acoustical joint sealants.

1.03 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- B. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.

1.06 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).

2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 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 MATERIALS, GENERAL

- 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 joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.02 POLYURETHANE JOINT SEALANTS

- A. Non-sag: ASTM C920 and FS TT-S-00227E, Type II Class A for non-sag type for vertical surfaces, non-staining type for porous and non-porous surfaces. Colors as selected from color line equal to Sika Corporations 40 designer color line. Use the following locations:
 - 1. At normal movement dynamic vertical joints and expansion-control joints.
 - 2. Under metal stud plates set on exterior foundation walls.
 - 3. At connections between exterior door frame, curtain wall and storefront frames, and window frame surfaces and adjacent wall construction.
 - 4. At all connections between hollow metal relite frames and plastic laminate finish.
 - 5. At all connections between window framing and interior casings if any.
 - 6. Under hemmed edge of window sill flashings.
 - 7. At all connections between exterior aluminum storefront/curtain wall frames and gypsum wallboard wall and ceiling finish.
 - 8. At all other locations where sealant is shown, and not noted in this section, except as specified otherwise to be furnished by painting trade under work of the Painting Section.
- B. Self-Leveling: ASTM C920 FS TT-S-0027E, Type I Class A self leveling type for horizontal surfaces, non-staining type for porous and non-porous surfaces. Standard color as selected. Use as horizontal expansion joints in concrete walks and slabs where sealant is shown.

2.03 LATEX JOINT SEALANTS

- A. General: Provide manufacturer's standard one-part, non-sag mildew resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.
- B. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.
 - 1. At interior locations where sealant is required which are subject to mildew.

2.04 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material 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.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. 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. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Sand: Furnish ASTM C144 Natural Sand, exact same color and type as furnished for masonry mortar for masonry walls.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to

comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Port may, at their choice, engage a firm to field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.

- b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. 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.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements. All retesting of failed sealant joints shall be at the Contractor's expense.

3.05 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 07 21 00.01 – “Thermal Insulation” for insulation at hollow metal frames.
 - 2. Section 08 71 00.01 - "Door Hardware" for door hardware for hollow metal doors.
 - 3. Section 09 91 23.01 - "Painting" and Section “09 96 00.01” - “High Performance Coatings” for field painting hollow metal doors and frames.
 - 4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.02 SUMMARY

- A. Section Includes:
 - 1. Hollow metal doors, frames and relites.

1.03 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.
- C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, factory primers and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles metal thicknesses and thermally broken.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Verification:
 - 1. For the following items, prepared on Samples about 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:

- a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.
- D. Other Action Submittals:
- 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.05 INFORMATIONAL SUBMITTALS

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

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.09 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Provide factory primer and field finish compatibility certification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Ceco Door Products; an ASSA ABLOY Group Company.
2. Curries Company; an ASSA ABLOY Group Company.
3. Republic Builders Products Company.
4. Steelcraft; an Ingersoll-Rand Company.
5. Stiles Custom Metals, Inc.
6. Or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00.

2.02 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- B. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- E. Frame Insulation: ASTM C665, 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.
- F. Insulating-Tempered Glass Lites: Factory-assembled units consisting of sealed lites of tempered glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Manufacturer's standard spacer material and construction.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- G. Dissimilar Materials Primer: High-solids surface tolerant epoxy equivalent to TNEMEC Series 135 ChemBuild.

2.03 HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard polyisocyanurate core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 12.3 deg F x h x sq. ft./Btu (2.166 K x sq. m/W) when tested according to ASTM C 1363. U Value 0.60.

- 1) Locations: Exterior doors.
3. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior and Interior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior and Interior Frames: Fabricated from metallic-coated steel sheet.
 1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames as full profile welded unless otherwise indicated.
 3. Frames for Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.
- C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

- A. Jamb Anchors:
 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.06 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.07 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

2.08 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Fully weld flush face joints and throats continuously, thermally broken; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Exterior frames to be flanged as detailed.
 - 3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 4. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 5. Where installed in masonry, leave vertical jambs in frames open at top for grouting. Do not grout mullions.
 - 6. Provide Spray foam insulation in any vertical or horizontal mullions.
 - 7. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 8. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.

- 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- b. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
9. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings, so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow metal work.
 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.09 STEEL FINISHES

- A. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-control paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 82 percent zinc dust by weight, as recommended by the door manufacturer, and compatible with the primer specified in Division 9 Sections for painting.
- B. Priming: Doors and frames to be factory epoxy primed and field finished.
- C. Protective Coating: In addition to the prime paint specified above for all surfaces of steel frames, for all steel frames, apply a coating of high-solid, surface tolerant epoxy paint over the prime paint to all concealed portions of the frame, for both building interior and exterior frames. This coating shall extend over all surfaces of the concealed portions of the assembled frame to provide additional corrosion protection from moisture. Verify epoxy coating paint is a rated assembly complying with UL tested Fire Ratings.

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 embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before installing spray foam.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Frame Insulation: Solidly pack mineral fiber insulation inside frames.
4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105 or UBC Standard 7-2 or IBC 715.4.3, as allowed by the agency having jurisdiction.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- D. Spot prepare primer in accordance with manufacturer instructions.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 08 71 00.01 – “Door Hardware” for cylinders provided under that Section for doors with locks under this Section.
 - 2. Section 08 80 00.01 – “Glazing” for glazing requirements for aluminum framed systems specified in this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Exterior storefront framing.

1.03 PREINSTALLATION MEETINGS

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

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For all aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation, licensed in the State of Washington.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source quality-control reports.
- E. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. Installer shall have a minimum of 5 years of experience installing systems similar to those specified in this section and shall provide proof of such. Representative projects shall be of similar or larger scale.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by the Engineer, except with Engineer's approval. If changes are proposed, submit comprehensive explanatory data to Engineer for review.
 - 2. Changes to performance characteristics and aesthetic effects will be considered by the Engineer during the bid phase through the substitution request process only. They will not be considered during construction. Only those changes approved by addenda may be incorporated into the project.

1.08 MOCKUPS

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area approved by Engineer.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: 5 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:

1. Wind Loads: Per ASCE 7-10, for additional information see Structural Notes.
 - a. Basic Wind Speed: 115 mph (51 m/s)
 - b. Exposure Category: B
 2. Seismic Loads: As indicated on Structural Drawings and as required by authorities having jurisdiction.
 - a. Importance Factor: $I = 1.25$
 - b. Risk Category: III
 3. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10.0 lbf/sq. ft.
- H. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.

2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.
- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.38 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 66 as determined according to NFRC 500.
- J. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1, and the current requirements of the International Building Code, as amended by the State of Washington, and adopted by the local jurisdiction.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.02 MANUFACTURERS

- A. Basis-of-Design Product:
 1. The exterior aluminum-framed systems are based on EFCO series "433 Thermal Triple Set Storefront Framing Frontset", at the building exterior, as illustrated on the Drawings. In addition to the Basis-of-Design manufacturer, and subject to compliance with requirements, other available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Kawneer North America; an Alcoa company.
 3. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.03 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken and Non-thermal as indicated by the basis of design products.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front for exterior 433 series.
 4. Finish: Colored anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.04 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L.

2.05 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.
- D. Exposed Flashing: Where indicated to be aluminum flashing, provide the manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finish to match framing and of sufficient thickness to maintain a flat appearance without visible deflection, and 0.040 inch minimum thickness. Some flashing also provided under Section 076200 "Sheet Metal Flashing and Trim", as indicated on the drawings.
- E. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.06 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior or exterior as is standard for the system specified.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system, at installer's discretion.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.07 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Black.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install flashing as detailed and in compliance with the requirements of Section 076200 "Sheet Metal Flashing and Trim".
- E. Install components plumb and true in alignment with established lines and grades.
- F. Install glazing as specified in Section 08 80 00 "Glazing."
- G. Install weatherseal sealant according to Section 07 92 00 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.03 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).

- b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
- 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Port may engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Port's testing agency may perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Engineer shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Additional testing and inspecting will be performed to determine compliance of replaced or additional work with the specified requirements. All additional testing resulting from failed tests will be completed at the Contractor's expense, including the testing agency, Port and Engineer.

3.05 MAINTENANCE SERVICE

- A. Hardware:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Port's continued adjustment, maintenance, and removal and replacement of operable units.
- B. Clean storefront framing and glazing within 7 days prior to school opening or Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1. Section 08 11 13.01 - "Hollow Metal Doors and Frames"

1.02 SUMMARY

- A. Section includes:

1. Provide complete door hardware and suitable fastenings for the Project in accordance with Drawings, Specifications, and Schedules.
2. Furnishing items of proper design for use on doors and frames of the size, thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function.
 - a. Provide UL Listed systems for exit doors.
 - b. Provide UL Listed systems for fire rated doors where scheduled.
 - c. Provide similar systems on non-latching doors where scheduled.
3. Furnishing items not specifically mentioned, but necessary to complete the work. These are to match quality and finish of the items specified.

- B. Quantities: Those listed in any instance are for subcontractor's convenience only and are not guaranteed.

1.03 REFERENCES

- A. Standards: Current edition at date of bid.

1. ADAAG - Americans with Disabilities Act, "Accessibility Guidelines for Buildings and Facilities"
2. ANSI/BHMA A156.18 - Materials and Finishes
3. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities
4. Underwriters Laboratories - Building Materials Directory

- B. Codes

1. International Building Code
2. Chapter 51-50 WAC Washington State Building Code

1.04 SUBMITTALS

- A. General Requirements: Submittals shall be in accordance with Section 01 33 00, Submittal Procedures.

- B. Product Data: Submit manufacturer's data for each item of Door Hardware

- C. Hardware Schedule: Submit Six a detailed Door Hardware Schedule.

1. The submitted Door Hardware Schedule shall indicate the complete designation of every item required for each door or opening.

2. Furnish cover sheet listing title of project as shown on the Contract Documents, address, phone and fax numbers of Port, Engineer, Contractor, and Supplier, name of Certified Hardware Consultant, and date of submittal.
 3. List each opening individually under separate headings, in the same order as the door schedule. Do not group like or similar doors under a single heading. Do not continue individual headings on separate pages.
 4. Each heading shall indicate opening location, handing, degree of opening, door and frame size, type, fire rating, and material.
 5. Indicate product manufacturer and incorporate cross-reference to symbols used in Article 2.04 Hardware Groups.
 6. A Key Schedule and index shall be included indicating door number, heading, page number, and locking function of each opening.
 7. A cross reference for any abbreviations or symbols used shall be included.
 8. Schedules in coded or horizontal format are unacceptable.
 9. Submittals not conforming to these requirements will be returned without review, for re-submittal.
- D. Revisions: The Door Hardware Submittal shall be kept current throughout the project duration. Revisions incorporated shall be submitted in accordance with the above requirements. Submit only cover sheet and revised pages. Clearly identify changes from previous submittal content.
- E. Samples: If requested by the Engineer, submit one (1) sample of each exposed hardware category, finished as required, and tagged with full description for coordination with the hardware schedule. Samples will be reviewed, by the Engineer, for design and finish only, compliance with other requirements is the responsibility of the Contractor. Units which are acceptable and remain undamaged through submittal procedures may be used on the project.
- F. Color Samples: Submit color charts and physical samples of each product requiring color selection.
- G. Key Schedule: Upon completion of the Key meeting, submit a key schedule indicating the complete project key system for approval. Obtain approval prior to proceeding with lock portion of the project.
- H. Operations and Maintenance Data. Prior to substantial completion, submit Maintenance and Operations Manuals, in accordance with 01 78 23 Operations & Maintenance manuals. Manuals shall contain final copy of the Door Hardware Submittal, Product Data, Key Schedule, Installation Instructions, and Warrantees.

1.05 QUALITY ASSURANCE

- A. Supplier:
1. Recognized Door Hardware supplier who has been furnishing hardware in the same area as the project for a period of not less than five (5) years.
 2. Factory direct, authorized, and stocking distributor of the Exit Devices, Locksets and Door Closers.
 3. Employ an Architectural Hardware Consultant (AHC), certified by the Door and Hardware Institute, who is available during the course of the work to meet with the Port, Engineer or Contractor for project hardware consultation.

- B. Source: Obtain each kind of Hardware (Butts, Locksets, Exit Devices, Door Closers, etc.) from only one manufacturer.
- C. Installer: Finish hardware shall be installed only by experienced tradesmen in compliance with trade union jurisdictions, either at the door and frame fabrication plant or at the project site.
- D. Templates: Furnish hardware templates for each fabricator of doors, frames and other work to be factory prepared for the installation of hardware. Upon request, check the shop drawings of such other work to confirm that provisions will be made for the proper installation of hardware.
- E. Regulatory Requirements:
 - 1. All finish hardware shall comply with applicable local and/or state current building codes. All Door Hardware shall meet the requirements of ADAAG, and ICC/ANSI A117.1 - Accessible and Usable Building and Facilities.
 - 2. Provide only hardware which has been tested and listed by recognized testing agency for the types and sizes of doors required, and which complies with the requirements of the door and door frame labels. Provide Door Closers, Automatic self latching bolts, coordinators, gasketing, astragals, or other components if required to conform to label requirements.

1.06 PRODUCT HANDLING AND STORAGE

- A. Packaging: Each item or package is to be separately tagged with identification related to the final hardware schedule. Basic installation instructions shall be included in the packages.
- B. Storage: Provide a locked room at the jobsite for the storage of the hardware.

1.07 WARRANTY

- A. Finish hardware shall be guaranteed against defects in workmanship and operation for a period of one (1) year, backed by a factory guarantee of the hardware manufacturer. The following products shall be guaranteed for periods beyond one year:
 - 1. Locks - two years
 - 2. Door Closers - ten years
 - 3. Panic Devices - three years

1.08 MAINTENANCE

- A. Furnish one set of special tools required for installation and adjustment which shall be delivered directly to the Port prior to substantial completion, in accordance with Closeout Procedures.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Products may be furnished by the manufacturers listed under "As Specified" below, or equivalent products of type, grade, design, and function from manufacturers listed under "Acceptable Substitutions". Requests for products not listed must be made in accordance with Division 01 Section "Product Requirements".

<u>Product</u>	<u>As Specified</u>	<u>Acceptable Substitutions</u>
Butt Hinges	McKinney (MC)	Bommer, Hager, Ives
Locksets	Best (BE)	None
Cylinders	Best (ME)	None

Exit Devices	Von Duprin (VO)	Sargent
Door Closers	LCN (LCN)	Sargent
Door Pulls	Trimco (TR)	Rockwood, Tice
Kick Plates	Tice (TI)	Rockwood, Trimco
Overhead Stops	Glynn Johnson (GJ)	ABH, Rixson
Weatherstrip &	Pemko (PE)	National Guard, Reese Thresholds

B. Finish: Finish in general shall be: US26D, Satin Chrome Plated, except:

1. Locksets: US32D, Satin Stainless Steel (BHMA 630).
2. Door Pulls: US32D, Satin Stainless Steel (BHMA 630).
3. Exterior Hinges: US32D, Satin Stainless Steel (BHMA 630).
4. Door Closers: Sprayed Aluminum (BHMA 689).
5. Kick Plates: US32D Satin Stainless Steel (BHMA 630).
6. Threshold, Weatherstrip & Door Bottoms: As listed

C. Butt Hinges:

1. Quantity (per Leaf):
 - a. Door openings up to 60": two each.
 - b. Door openings 60 to 90": three each.
 - c. Doors over 90": Furnish one additional for each 30" increment or fraction thereof.
2. Sizes:
 - a. 1-3/4" Exterior & Vestibule Doors: 5 x 4-1/2"
 - b. 1-3/4" Interior Doors up to and including 36": 4-1/2 x 4-1/2"
 - c. 1-3/4" Interior Doors over 36" -- 5 x 4-1/2"
3. Width of Hinges shall be as required to clear projecting trim or other conditions to allow maximum degree of opening.
4. Hinges shall have Flat Button Tips.
5. Hinges shall have non-removable pins (NRP - Set Screw in Barrel).
6. For unusual size or weight doors, furnish type, size and quantity recommended by the hinge manufacturer.

D. Locksets and Cylinders

1. Furnish Lever Handle Locksets and Latches in 15M Design.
2. Backset: 2-3/4"
3. Cylinders:
 - a. Furnish Locksets and Cylinders capable of accepting "Small Format" Key Removable Interchangeable Cores.
 - b. Provide appropriate Cylinder Collars, Blocking Rings, and Cams are required for each application

4. Locksets and Latchsets shall be listed with Underwriters Laboratories for A label and lesser class doors.
 5. Provide Knurled Levers at hazardous locations (i.e.: Mechanical, Electrical Rooms)
 6. Provide Curved Lip Strikes with adequate projection to protect door trim.
 7. Provide manufacturers standard wrought or plastic strike boxes.
 8. Coordinate location, rough-in, and voltage requirements for Electronic Lock and Electric Strikes with electrical sub-contractor.
- E. Panic Devices and Fire Exit Hardware
1. Furnish Sex Nuts and Bolts at Wood Composite and Mineral Core Door applications.
 2. Provide UL listed Fire Exit Devices at rated openings.
 3. Provide Exit Devices sized in accordance with the manufacturer manufacturers recommendations.
 4. Provide Glass Bead Kits where interference with vision frames occurs.
- F. Door Closers
1. Drop Plates: Furnish drop plates where doors have insufficient height top rails, or where Regular Arm Door Closers are used in conjunction with Concealed Overhead Stops.
 2. Fluid: Furnish cold weather fluid, at exterior & vestibule doors. Furnish non-flammable fluid at fire rated openings in conformance with UL Test Standard 10C.
 3. Spacer Blocks: Furnish Spacer Blocks and/or shoe supports where frame stop does not provide for adequate support for the parallel arm soffit shoe.
 4. Special Mounting: Provide special closer mounting as required where interference with weatherstrip or sound seals occurs.
- G. Kick Mop, and Armor Plates
1. Kick and Armor Plates shall be applied to the push side of the Door, Mop Plate applied to the pull side.
 2. Height: Kick Plates 10", Mop Plates 6", Armor Plates 34".
 3. All plates shall beveled four edges (B4E) and countersunk for screws.
 4. All plates shall be furnished with width as required to provide 1/4" clearance at sides of doors, frame stops, and stop or mullion applied seals.
- H. Stops & Holders
1. Furnish Overhead Stop and Holders sized as recommended by manufacturer.
 2. Furnish Overhead Stop and Holders with special shims, brackets, or special template mounting where required.
 3. Where wall stops are not applicable, furnish floor stops 1215CKU Series, or Overhead Stops if required.
- I. Thresholds
1. Furnish all Thresholds with 1/4" - 20 x 2" Flat Head Sleeve Anchors (FHSL14200).
- J. Weatherstrip and Smoke Gasketing

1. Furnish weatherstrip and gaskets for complete perimeter of opening, including mullions, and astragals. Furnish weatherstrip at sill of Four (4) sided frames.
2. Rain Drips shall be full width of opening including frame faces.

2.02 KEYING

- A. The Key Cylinders specified under this Section shall be keyed under the existing Port of Tacoma Best Key System.
- B. Provide Brass Construction Cores and Keys during the construction period. Plastic Construction Cores are unacceptable.
- C. The Door Hardware Supplier shall meet with the Port to prepare the permanent keying schedule.
- D. The Permanent Cores, Change Keys, and Control Keys, prepared according to the approved keying schedule, shall be transmitted directly to the Port, prior to substantial completion. The Door Hardware Supplier shall remove the construction cores and install the permanent cores. Demonstrate proper operation and keying All Construction Cores shall be returned to the Door Hardware Supplier.
- E. The Permanent Cores and Keys shall be sent direct from the lock manufacturer via Registered Mail, Return Receipt Requested, to the Contracting Officer.
- F. Provide a key transcript list of the keys and cylinders.
- G. Stamping: Stamp all Keys "Do not Duplicate" and with change designation as directed.
- H. Furnish:
 1. Four change keys per Lockset or Cylinder.
 2. Two Control Keys
 3. Two Construction Control Keys
 4. Two Construction Keys

2.03 HARDWARE GROUPS

HW-1

DOORS #100A, 100B, 100C, 100D

6	EACH HINGES	MC	T4A3386
1	EXIT DEVICE	VO	CD9827L
1	RIM CYLINDER	BE	1E72
1	EXIT DEVICE	VO	CD9827L
2	MORTISE CYLINDERS	BE	1E74
2	DOOR CLOSERS	LCN	4040XP SPRING-CUSH X ST1595
2	KICK PLATES	TI	B4EKP
1	THRESHOLD	PE	2727A
1	SET WEATHERSTRIP	PE	290AS (HEAD) X 290AS (JAMBS)
2	DOOR SWEEPS	PE	315CN
1	SET MEETING STILE SEALS	PE	351C/351CP

HW-2

DOORS #101A, 103A

3	EACH HINGES	MC	T4A3786
1	PUSH PLATE	TR	1001-11
1	PULL PLATE	TR	1014-3
1	DOOR CLOSER	LCN	4040XP-RA
1	KICK PLATE	TI	B4EKP
1	MOP PLATE	TI	B4EMP
1	WALL STOP	TR	1270CX
3	SILENCERS		

HW-3

DOOR #102A

6	EACH HINGES	MC	T4A3386
1	STOREROOM LOCKSET	BE	45H7D15M
2	FLUSH BOLTS	TR	3917 – 12"
1	DUST PROOF STRIKE	TR	3911
1	DOOR CLOSER (ACTIVE LEAF)	LCN	4040XP SPRING-H-CUSH X ST1595
1	OVERHEAD STOP & HOLDER	GJ	90H SERIES

2	KICK PLATES	TI	B4EKP
1	THRESHOLD	PE	2727A
1	SET WEATHERSTRIP	PE	290AS (HEAD) X 290AS (JAMBS)
2	DOOR SWEEPS	PE	315CN
1	ASTRAGAL	PE	357SP X S88D X TB

HW-4

DOOR #104A

3	EACH HINGES	MC	TA2714
1	STOREROOM LOCKSET	BE	45H7D15M
1	OVERHEAD STOP	GJ	90S SERIES
1	KICK PLATE	TI	B4EKP
1	MOP PLATE	TI	B4EMP – 10" HIGH
3	SILENCERS		

HW-5

DOORS #106A, 107A

3	EACH HINGES	MC	TA2714
1	OFFICE LOCKSET	BE	45H7AT15M
1	KICK PLATE	TI	B4EKP
1	WALL STOP	TR	1270CX
1	SET GASKET	PE	S88D

HW-6

DOOR #108A

3	EACH HINGES	MC	T4A3386
1	EXIT DEVICE	VO	98NL
1	RIM CYLINDER	BE	1E72
1	DOOR CLOSER	LCN	4040XP SPRING-CUSH X ST1595
1	KICK PLATE	TI	B4EKP
1	THRESHOLD	PE	2727A
1	SET WEATHERSTRIP	PE	290AS (HEAD) X 290AS (JAMBS)
1	DOOR SWEEP	PE	315CN

HW-7

DOOR #110A

3	EACH HINGES	MC	TA2714
1	LATCHSET	BE	45H0N15M
1	KICK PLATE	TI	B4EKP
1	WALL STOP	TR	1270CX
3	SILENCERS		

HW-8

DOOR #200A

3	EACH HINGES	MC	T4A3786
1	STOREROOM LOCKSET	BE	45H7D15M
1	DOOR CLOSER	LCN	4040XP-EDA
1	KICK PLATE	TI	B4EKP
1	WALL STOP	TR	1270CX
1	SET GASKET	PE	S88D

HW-9

DOORS #202A, 203A

3	EACH HINGES	MC	TA2714
1	PRIVACY LOCK	BE	45H0L15H
1	OCCUPIED INDICATOR	TI	TYPE C
1	DOOR CLOSER	LCN	4040XP-RA
1	KICK PLATE	TI	B4EKP
1	MOP PLATE	TI	B4EMP
1	WALL STOP	TR	1270CX
3	SILENCERS		

HW-10

DOORS #205A, 206A, 207A, 208A, 209A, 210A

3	EACH HINGES	MC	TA2714
1	OFFICE LOCKSET	BE	45H7AT15M
1	WALL STOP	TR	1270CX
1	SET GASKET	PE	S88D

HW-11

DOOR #211A

3	EACH HINGES	MC	T4A3386
1	EXIT DEVICE	VO	98NL
1	RIM CYLINDER	BE	1E72
1	DOOR CLOSER	LCN	4040XP-EDA X ST1944
1	KICK PLATE	TI	B4EKP
1	FLOOR STOP	TR	1233
1	THRESHOLD	PE	2727A
1	SET WEATHERSTRIP	PE	290AS (HEAD) X 290AS (JAMBS)
1	DOOR SWEEP	PE	315CN

HW-12

DOOR #212A

3	EACH HINGES	MC	T4A3786
1	STOREROOM LOCKSET	BE	45H7D15M
1	DOOR CLOSER	LCN	4040XP SPRING-CUSH
1	KICK PLATE	TI	B4EKP
1	SET GASKET	PE	S88D

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examination: Examine Doors, Frames, and related items for conditions that would prevent the proper application and operation of the Doors and Finish Hardware. Do not proceed until defects are corrected.
- B. Provide solid blocking for wall mounted components.
- C. Fasteners: Check all conditions and use fastening devices as needed to securely anchor all hardware as per manufacturer's published templates. Self-tapping sheet metal screws are not acceptable. Door Closers, Exit Devices, and Surface Mounted Overhead Stops shall be applied to wood composite and mineral core doors with Shoulder through bolts.

3.02 INSTALLATION

- A. Mounting Heights: Mounting Heights: Mount units at heights as recommended in "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames (2001)" by Doors and Hardware Institute, except as indicated below. Products not specifically covered shall be installed in accordance with the manufacturer templates and instructions.
 1. Hinges:
 - a. Top Hinge: 7'-1/4", Top of frame rabbet to centerline of hinge.

- b. Bottom Hinge: 12-1/4", Bottom of Frame to centerline of hinge
 - c. Intermediate Hinges: Centered, equal spacing between top and bottom hinges.
- 2. Mortise Lock Strikes: 40", bottom of frame to centerline of Strike.
- 3. Wall Stops: Locate Wall Stops intended for use with Lever Handle Locksets and Exit Devices at the Centerline of the Spindle or Pull.
- 4. Push and Plates: 42", bottom of frame to centerline of Plate.
- B. Install each hardware item in compliance with manufacturer's instructions.
 - 1. Cutting and Fitting: Wherever cutting and fitting are required to install hardware surfaces which will be painted or finished at a later time, install each item completely and then remove and store in a secure place. After completion of the finishes, re-install each item.
 - 2. Door and Frame Finishes: Do not install surface-mounted items until finishes have been completed on the substrate.
 - 3. Fire Rated Openings: Install in accordance with NFPA 80.
 - 4. Doors shall swing to the maximum degree that project conditions will allow. The swings indicated on the floor plan are intended to depict direction and do not indicate full degree of opening,
 - 5. Exit Devices: Trim Exit Devices to provide 1-1/2" clearance between End Cap and hinge jamb stop face and/or stop applied weatherstrip.
 - 6. Door Closers: Door Closer shall be located to allow maximum degree of opening that project conditions will allow. Door Closer shall not be used to stop the door, except for models equipped with an integral stop-on-the-arm feature.
 - 7. Overhead Stops: Furnish Overhead Stop and Holders with maximum degree of opening that project conditions will allow.
 - 8. Thresholds: Set all Exterior Thresholds in a bed of butyl rubber sealant in conformance with Division 7 requirements. Remove excess sealant. Caulk edges and joints to exclude moisture.
 - 9. Weatherstrip: Mount and adjust Rigid Jamb Weatherstrip prior to mounting Parallel Arm Door Closers. Weatherstrip shall be installed to provide a continuous seal at head and jambs. Do not notch Weatherstrip for Door Closer shoe. Provide Parallel Arm 5th hole spacer of increased thickness to allow for revised location.
 - 10. Smoke Gasket
 - a. Completely clean frame and apply gasket in accordance with manufacturer's instructions.
 - b. Mount Gasket in accordance with Pemko's instructions for alternative mounting.
- C. Adjust and check each operating item of hardware and each door to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

3.03 ADJUSTMENT

- A. Final Adjustment: Wherever hardware installation is made more than one (1) month prior to acceptance or occupancy, make a final check and adjustment of all hardware items during the week prior to acceptance or occupancy. Clean and lubricate operating items as necessary to

restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Door Closer Adjustment: After mechanical systems have been balanced, adjust Door Closers to comply with following ICC/ANSI A117.1 requirements, as modified by WAC 51-50 and International Building Code:

1. Closing Speed: Door Closers shall be adjusted so that from an open position of 90 degrees, the time required to move the door to an open position of 12 degrees shall be 5 seconds minimum.
2. Opening Force: The maximum force for pushing or pulling a door open shall be as follows: (these forces do not apply to the force required to retract latch bolts or disengage other devices securing the door).
 - a. Exterior Doors: 10.0 lbf (44.4 N).
 - b. Interior Doors: 5.0 lbf. (22.2 N.)
3. Adjust backcheck to prevent damage to the closer, hardware, door and frame, and wall.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 08 11 13.01 – “Hollow Metal Doors and Frames.”
 - 2. Section 08 41 13.01 – “Aluminum-Framed Entrance and Storefronts.”

1.02 SUMMARY

- A. Section includes:
 - 1. Glass for windows, doors, and storefront framing
 - 2. Glazing sealants and accessories.
 - 3. Composite spandrel panels

1.03 DEFINITIONS

- A. Glass Manufacturers: Firms that either produce primary glass or fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.04 COORDINATION

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

1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.06 ACTION SUBMITTALS

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

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Product Test Reports: For coated glass and insulating glass, for tests performed by a qualified testing agency.
- D. Sample Warranties: For special warranties.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer whose location and equipment is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

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

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by any manufacturer meeting the requirements of this section, unless a specific manufacturer is specified herein.

1. Guardian Industries Corp.;
 2. PPG Industries, Inc.
 3. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Glass Fabricators: Subject to compliance with requirements, provide fabricated glass by any of the fabricators meeting the requirements of this section.
1. Garibaldi Glass- Burnaby, BC
 2. Hartung Glass- Tukwila, WA
 3. Northwestern Industries-Seattle, WA
 4. Oldcastle BuildingEnvelope- Battle Ground, WA
 5. Viracon- Owatona, MN
 6. Vitrum Industries- Langley, BC
- C. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
1. Obtain tinted glass from single source from single manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings, unless indicated otherwise on the Drawings, or unless indicated otherwise in other sections.
 - a. Wind Design Data: As indicated on Drawings and as required to meet local loads.
 - b. Wind Loads: Per ASCE 7, for additional information see Structural Notes.
 - c. Basic Wind Speed: 115 mph (51 m/s)
 - d. Exposure Category: B
 2. Maximum Lateral Deflection: The center-of-glass deflection of the glazing shall be limited so that all of the following requirements are met:
 - a. The structural capacity of the glazing composition is not exceeded.
 - b. The glazing composition remains reliably engaged with suitable margin of safety under the most critical design condition.
 - c. The center-of-glass deflection does not exceed 1"

- d. The center-of-glass deflection does not exceed the short side dimension of the unit divided by 100.
- C. Safety Glazing: Where indicated on the drawings and where required by code and load conditions, even if not indicated on the drawings, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- E. Thermal Loading: Design glass to resist thermal loads at service including those induced by differential shading within individual glass lites.

2.03 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior and Interior Lites: 1/4 inch, unless indicated otherwise.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article, but not less than minimum thickness noted above. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article, but not less than minimum thickness noted above. Where fully tempered float glass is indicated, provide fully tempered float glass.
- F. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise specified.
 2. Optical Distortion Limits: Maximum peak-to-valley roll wave 0.005" (0.127 mm) in the central area of the glass lite; and 0.015" (0.381 mm) within 12" of the leading and trailing edge of the lite, per ASTM C 1651. This section applies only to 1/4" (6 mm) to 3/8" (10 mm) thick float glass without ceramic frit or ink.
 3. Maximum center-kink of 0.001" (0.025 mm) when roll wave is measured over the surface of the glass perpendicular to the direction of travel through the tempering furnace.
 4. Maximum localized bow (warp) per lite shall be 1/32" (0.79 mm) per lineal foot, one-half of the ASTM C 1048 allowance. Maximum overall bow (warp) per lite shall also be one-half of the ASTM C 1048 allowance.
 5. Fully tempered glass should only be used where required by code for safety, thermal stress, load or other specification requirements. Heat-strengthened glass should be used unless tempered glass is specifically required. All tempered glass shall conform with ANSI Z97.1 and CPSC 16 CFR 1201.
- G. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. Optical Distortion Limits: Maximum peak-to-valley roll wave 0.005" (0.127 mm) in the central area of the glass lite; and 0.015" (0.381 mm) within 12" of the leading and trailing edge of the lite, per ASTM C 1651. This section applies only to 1/4" (6 mm) to 3/8" (10 mm) thick float glass without ceramic frit or ink.
 3. Maximum center-kink of 0.001" (0.025 mm) when distortion is measured over the surface of the glass perpendicular to the direction of travel through the tempering furnace.
 4. Maximum localized bow (warp) per lite shall be 1/32" (0.79 mm) per lineal foot, one-half of the ASTM C 1048 allowance. Maximum overall bow (warp) per lite shall also be one-half of the ASTM C 1048 allowance.
 5. Heat-strengthened glass should be used unless tempered glass is specifically required

2.04 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.05 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 1. Sealing System: Dual seal, polyisobutylene primary and silicone secondary.
 2. Spacer: Manufacturer's standard spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.
4. Edge Deletion: Delete low E prior to fabrication of insulating units according to coated glass manufacturer's instruction.
5. Refer to Window Schedule for assembly and glass U-values.

2.06 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.07 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.08 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.09 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.10 COMPOSITE SPANDREL PANELS (SPP)

- A. Spandrel Panels: Where composite spandrel panels are indicated, provide the following, or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
 - 1. "Mapes-R, Insulated Composite Panels."
 - a. Thickness: 1 inch.
 - b. Finish: Custom Kynar finish to match interior accent color.
 - c. Substrate: 1/8" hardboard or cement board as recommended by manufacturer.
 - d. Core: Polystyrene.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.04 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

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

3.06 SEALANT GLAZING (WET)

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

3.07 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08 MONOLITHIC GLASS SCHEDULE

- A. Uncoated Clear Float Glass: Where glass as designated below is indicated, provide Type I (transparent glass, flart), Class 1 (clear) glass lites complying with the following:
 - 1. Uncoated Clear Annealed Float Glass – Scheduled as “F”: on drawings: Provide in ¼ inch thickness, unless noted otherwise.
 - 2. Uncoated Clear Fully Tempered Float Glass – Scheduled as “T”: on drawings: Kind FT (fully tempered). Provide in ¼ inch thickness, unless noted otherwise. Provide 3/8 inch

thick at interior doors and relites and other thicknesses where specifically noted on drawings.

3.09 INSULATING GLASS SCHEDULE

- A. Insulating Glass: Where glass of this designation is indicated, provide insulating-glass units complying with the following:
1. Drawing Schedule Designations:
IFF: Insulated / Float (interior pane) / Float (exterior pane)
ITT: Insulated / Tempered (interior pane) / Tempered (exterior pane)
 2. Overall Unit Thickness: 1 inch.
 3. Indoor Lite:
 - a. Class 1 clear float glass, clear tempered glass, or clear laminated glass as scheduled on the Drawings. Provide glass types and thickness as specified herein.
 4. Outdoor Lite:
 - a. Float glass, tempered glass, or laminated glass as scheduled on the Drawings. Provide glass types and thickness as specified herein. Glass shall be of the following type:
 - 1) Class 1 clear glass, unless noted otherwise on drawings for the following types of glass.
 5. Low-E Insulating Glass: Place Low-E coating on the number 2 surface, except where exterior pane is laminated, the Low-E coating may be applied to the number 4 surface.
 - a. All Exterior Glass, unless otherwise noted on Window Schedule: Provide low-emissivity insulating-glass units – Low-E magnetic sputter vacuum deposit coating:
 - 1) Basis if Design: Guardian SN 54 on clear
 - 2) Also acceptable: PPG Solarban 67 on clear or Viracon VUE 1-50
 6. Interspace Content: Argon.
 7. Winter Nighttime U-Factor: 0.24 for basis of design product, clear glass.
 8. Visible Light Transmittance: 54% minimum visible, for basis of design product, clear glass.
 9. Total Solar Energy Transmittance: 23% for basis of design product, clear glass.
 10. Total Solar Energy Reflectance: 33% for basis of design product, clear glass.
 11. Shading Coefficient: 0.31 maximum for basis of design product, clear glass
 12. Solar Heat Gain Coefficient: 0.27 maximum for basis of design product, clear glass
 13. Light to Solar Gain: 1.95 minimum for basis of design product, clear glass
 14. Provide safety glazing labeling.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.
- B. Section 06 10 0.01 – “Rough Carpentry” for framing.

1.02 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies (horizontal and vertical).

1.03 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.04 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For shaft wall assemblies, from ICC-ES.

1.05 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency and as approved by authorities having jurisdiction.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Protection: Stored and installed materials shall be protected and kept dry at all times. Any gypsum or related materials that become wet or damaged shall be removed and replaced with new materials.
- C. Do not install interior products until installation areas are enclosed and conditioned.
- D. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.

- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - 1. Depth: As indicated.
 - 2. Minimum Base-Metal Thickness: 20 gauge minimum, or heavier where required to comply with structural performance requirements for stud depth indicated. Also see Structural Drawings for possible requirements which supersede these requirements except stated minimum gauge.
- D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: 20 gauge minimum, or heavier where required to comply with structural performance requirements for stud depth indicated. Also see structural Drawings for possible requirements which supersede these requirements except stated minimum.
- E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- F. Elevator Hoistway Entrances: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm) thick.
- G. Room-Side Finish: As indicated.
- H. Shaft-Side Finish: Gypsum shaftliner board, Type X.

2.02 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; ProRoc Shaftliner.
 - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
 - c. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
 - 2. Thickness: 1 inch (25.4 mm).
 - 3. Long Edges: Double bevel.
- C. Gypsum Board: As specified in Division 09 Section "Gypsum Board."
- D. Cementitious Backer Units: As specified in Division 09 Section "Gypsum Board."

2.03 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 1. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
- B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly

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

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. Steel Network Inc. (The); VertiClip SLD Series.

2.04 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Division 09 Section "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Division 07 Section "Thermal Insulation."
- F. Acoustical Sealant: As specified in Division 09 Section "Gypsum Board."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturers written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
 - 2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Engineer, and as indicated on the drawings, while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Cant Panels: At projections into shaft exceeding 4 inches (102 mm), and where indicated, install 1/2- or 5/8-inch- (13- or 16-mm-) thick gypsum board cants covering tops of projections.
 - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
 - 2. Where steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.03 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 06 10 00.01 – “Rough Carpentry” for framing and suspension systems that support gypsum board panels.
 - 2. Section 06 16 00.01 – “Sheathing” for gypsum sheathing for exterior walls.

1.02 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.
 - 3. Texture finishes.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.04 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wall coverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.

1.05 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack

panels flat and supported on risers on a flat platform to prevent sagging. Any gypsum or related materials that become wet or damaged shall be removed and replaced with new materials.

1.07 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned. Maintain conditioning continuously once gypsum board installation begins through Substantial Completion, without interruption.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.01 GYPSUM BOARD, GENERAL

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

2.02 INTERIOR GYPSUM BOARD (GWB)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. Lafarge North America Inc.
 - 5. National Gypsum Company.
 - 6. PABCO Gypsum.
 - 7. Temple-Inland.
 - 8. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm), typical, unless specifically indicated otherwise on drawings.
 - 2. Long Edges: Tapered.
 - 3. Location: For all locations where gypsum wall board, "GWB," is indicated on the Drawings for fire rated and non-fire rated assemblies, except as noted herein.
- C. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M.
 - 1. Type X:
 - a. Thickness: 5/8 inch, typical, unless specifically indicated otherwise on drawings.

- b. Long Edges: Tapered.
- c. Location: For all Restrooms at non-tiled walls, Fire Sprinkler Riser Room walls, at kitchen areas, Custodian's Room walls, walls in rooms subject to moisture, and where indicated on drawings, GWB.

2.03 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Tile Backer.
 - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
 - c. Or approved substitute during the Bid Process per Instructions to Bidders and Specification Section 00 26 00.
 - 2. Core: 5/8 inch (15.9 mm), Type X.
 - 3. Mold Resistance: ASTM D 3273, score of 10.
 - 4. Location: For all areas where tiles is on walls

2.04 TRIM ACCESSORIES

- A. Standard Interior Trim: ASTM C 1047.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by any manufacturer meeting the requirements of this section for standard trim shapes.
 - 2. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized steel sheet.
 - 3. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Pull-away Pre-mask L-Bead: Use at all windows storefront and curtain wall. "Trim-TeX" "Pullaway" Pre-mask L-Bead or similar.
 - f. Expansion (control) joint.
 - g. "Z" Bead: Trim Tex AS 5810.
 - h. Reveal Bead: Trim Tex AS 5150.
 - i. Reveal Bead Crosspiece: Trim Tex AS 500 C, AS 500 T.
 - j. Flush Expansion Bead: Trim Tex Hideaway 2710.
 - k. Picture Tail: Fry Reglet Picture Rail DRMH-50 with DRMH-50 insert hangers. Provide 1 hanger per 48 inches of track.
- B. Aluminum Trim: Provide standard and custom aluminum trim shapes where indicated on the drawings, and of the type indicated on the drawings. Provide in finish and color indicated on

drawings, factory applied. Provide Fry Reglet, Gordon or equivalent meeting the standards of this Section.

2.05 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.06 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Insulation: As specified in Division 07 Section "Thermal Insulation."
- F. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except where indicated otherwise.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at sides of these locations and 1 inch below at designated deflection joints (unless noted otherwise), and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings.
 - 2. Type X: At all locations.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.05 INSTALLING TRIM ACCESSORIES

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

3.06 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 3: Where indicated herein.
 - 4. Level 4: Where indicated herein.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.07 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.
- C. Texture Schedule: Install the following textures on gypsum board walls and ceiling, unless otherwise indicated on drawings or schedules:
 - 1. Electrical Rooms, Mechanical Rooms, Attic Rooms / Spaces, Mechanical Attics, and Mechanical Mezzanines: Smooth Level 3 finish.
 - 2. All Other Rooms: Smooth Level 4 finish.

3.08 PROTECTION

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

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

1. Section 09 29 00.01 – “Gypsum Board” for glass-mat, water-resistant backer board.

1.02 SUMMARY

- A. Section Includes:
1. Ceramic tile.
 2. Glass tile
 3. Waterproof membrane.
 4. Metal edge strips.

1.03 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.04 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
1. Level Surfaces: Minimum 0.6.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- C. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
 3. Full-size units of each type of trim and accessory for each color and finish required.
 4. Stone thresholds in 6-inch (150-mm) lengths.

5. Metal edge strips in 6-inch (150-mm) lengths.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, signed by product manufacturer.
- D. Material Test Reports: For each tile-setting and -grouting product.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be regularly engaged in installation of the systems specified, thoroughly familiar with materials and techniques, employing skilled workmen, provide proof of at least 10 similar installations in good condition, shall be established in the tile installation business for not less than 5 continuous years under the same name and shall have not less than 5 years experience in installation of similar tile systems.
- B. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 1. Stone thresholds.
 2. Waterproof membrane.
 3. Joint sealants.
 4. Metal edge strips.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. FloorScore Compliance: Tile systems for floors shall comply with requirements of FloorScore Standard.
- D. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.
- G. Basis-of-Design Product:
 - 1. Tile: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
 - 2. Grout: Grout shall be of a manufacturer meeting these specifications, with colors that are acceptable to the Engineer.
- H. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specified products or materials complying with the following requirements:

2.02 TILE PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, and provided they have products of similar size and color to the basis-of-design product, provide one of the products specified.
 - 1. Daltile; Div. of Dal-Tile International Inc.
 - 2. Or approved substitution during bidding per Instructions to Bidders and Specification Section 00 26 00.
 - 3. Product and Colors: See Color Schedule on Drawings.
- B. Un-glazed Porcelain Mosaic Tile (Floor - Field): Factory-mounted flat tile as follows:
 - 1. Composition: Porcelain.
 - 2. Surface: Slip resistant, with abrasive admixture.
 - 3. Module Size: 2" x 2"
 - 4. Nominal Thickness: 3/8 inch
 - 5. Face: Pattern of design indicated
 - 6. Basis-of-Design Product: COLORBODY PORCELAIN FABRIQUE line.
 - 7. Location: Floors scheduled to receive porcelain tile (PT).
- C. Glazed Ceramic Mosaic Tile (Floor - Accent): Factory-mounted flat tile as follows:
 - 1. Composition: Ceramic.
 - 2. Surface: Smooth.
 - 3. Module Size: 2" x 2"
 - 4. Nominal Thickness: 5/16 inch
 - 5. Face: Pattern of design indicated, with cushion edges.
 - 6. Basis-of-Design Product: ECO-BODY "Natural Hues" line.
 - 7. Location: Floors scheduled to receive ceramic tile (CT).
- D. Glazed Ceramic Tile – Interior Walls (Field): Factory-mounted flat tile as follows:
 - 1. Composition: Ceramic.
 - 2. Module Size: 4 1/4 x 4 1/4 inches.
 - 3. Thickness: 5/16 inch.
 - 4. Grout Joint: 1/8 inch
 - 5. Face: Pattern of design indicated, with cushion edges.
 - 6. Trim: Provide bullnose
 - 7. Basis-of-Design Product: "GLAZED WALL AND COUNTER SEMI GLOSS" line.
 - 8. Location: Interior walls scheduled or noted to receive ceramic tile (CT).
- E. Ceramic Mosaic Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - 1. Base Cove: Cove, module size to match the adjoining tile.

2. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.

2.03 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Locations for Use: Install at floors under all ceramic tile, and behind all wall tile.
- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
 - b. MAPEI Corporation; Mapelastic L (PRP M19).

2.04 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15); or polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.05 GROUT MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide one of the products specified. They must, however, be able to provide the specified epoxy grout materials in the specified joint widths, and in colors acceptable to the Engineer to receive approval.
 1. LATICRETE International Inc.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D.
 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F (60 deg C) and 212 deg F (100 deg C), respectively, and certified by manufacturer for intended use.
- C. Grout for Pre-grouted Tile Sheets: Same product used in factory to pre-grout tile sheets.

2.06 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."
 - 1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. Chemical-Resistant Sealants: Provide chemical-resistant elastomeric sealant of type recommended and produced by chemical-resistant mortar and grout manufacturer for type of application indicated, with proven service record and compatibility with tile and other setting materials, and with chemical resistance equivalent to mortar/grout.

2.07 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.08 MIXING MORTARS AND GROUT

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

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances

that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return tile to manufacturer or blend tiles at Project site before installing.

3.03 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to

minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
 2. Glazed Wall Tile: 1/16 inch (1.6 mm).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Metal Edge Strips: Install at locations indicated, and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.04 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.05 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove epoxy grout residue from tile as soon as possible.
 2. Clean grout smears, and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.06 FLOOR TILE INSTALLATION SCHEDULE

- A. Tile Installation at slab on grade floor construction: Interior floor installation on waterproof membrane over concrete cement mortar bed (thickset) epoxy grout; TCA F121 and ANSI A108.1A.
 - 1. Tile Type: Unglazed ceramic mosaic.
 - 2. Grout: Chemical-resistant, water-cleanable, tile-setting and –grouting epoxy.
- B. Tile Installation at slab on metal deck floor construction: Interior floor installation on waterproof membrane over concrete; thin-set mortar; TCA B422 and ANSI A118.10.
 - 1. Tile Type: Unglazed ceramic mosaic tile.
 - 2. Thin-Set Mortar: Latex-portland cement mortar.
 - 3. Grout: Chemical-resistant, water-cleanable, tile-setting and –grouting epoxy.

3.07 WALL TILE INSTALLATION SCHEDULE

- A. Tile Installation at all Walls: Interior wall installation over glass-mat, water-resistant backer board with waterproof membrane; thin-set mortar; TCA B422 and ANSI A118.10.
 - 1. Tile Type: Glazed ceramic tile.
 - 2. Thin-Set Mortar: Latex-portland cement mortar.
 - 3. Grout: Chemical-resistant, water-cleanable, tile-setting and –grouting epoxy.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Divisions 23, 26 and 33 Sections for coordination of mechanical, electrical and fire sprinklering items installed in/on ceiling grids.

1.02 SUMMARY

- A. Section includes acoustical panels, and exposed suspension systems for ceilings.

1.03 PREINSTALLATION MEETINGS

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

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be regularly engaged in installation of the systems specified, thoroughly familiar with materials and techniques, employing skilled workmen, provide proof of at least 10 similar installations in good condition, shall be established in the suspended ceiling installation business for not less than 5 continuous years under the same name and shall have not less than 5 years experience in installation of similar systems.
- B. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - 2. ASTM Standard C636, "Standard Practice for Installation of Metal Ceiling Suspension System for Acoustical Tile and for Lay-in Panels."

1.09 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 450 or less.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.11 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.01 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Engineer from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.02 ACOUSTICAL PANELS: CEILING TYPE 1 - CEILING PANELS WITH HIDDEN GRID.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide
 - 1. Armstrong; "OPTIMA" TEGULAR for 2x4 panels.
 - 2. Comparable product by USG.
 - 3. Or approved substitute during the Bid Process, per Instructions to Bidders and Specification Section 00 26 00.
- B. Locations: For all ceilings where 2x4 (Type VII acoustical panels) with a hidden grid are indicated, unless noted otherwise.
- C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type and form matching the basis of design product.
 - 2. Pattern: As indicated by manufacturer's designation.
- D. Color: White.
- E. AC: Not less than 180.
- F. NRC: Not less than 0.90.
- G. Suspension System: OPTIMA Tegular With Suprafine 9/16", or comparable products as compatible with systems of approved ceiling panel manufacturer.
- H. Edge/Joint Detail: ARMSTRONG Vector For Hidden Grid , or comparable products as compatible with systems of approved ceiling panel manufacturer.

- I. Thickness: One inch.
- J. Modular Size: 24 by 48 inches (610 by 1220 mm), as indicated on the drawings.
- K. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Inherent Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.03 ACOUSTICAL PANELS: CEILING TYPE 5 - CEILING PANELS WITH HIDDEN GRID.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong; "OPTIMA" Tegular for 48" x 96" panels, or comparable products, as compatible with systems of approved ceiling panel manufacturer.
- B. Locations: For all ceilings where 48" x 96" (Type VII acoustical panels) are indicated, unless noted otherwise.
- C. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type and form matching the basis of design product.
 - 2. Pattern: As indicated by manufacturer's designation.
- D. Color: White.
- E. AC: Not less than 180.
- F. NRC: Not less than 0.90.
- G. Suspension System: OPTIMA AND SPECTRA CAPZ, 3931 as Manufactured by Armstrong World Industries or comparable products as compatible with systems of approved ceiling panel manufacturer.
- H. Edge Profile: Reverse Tegular
- I. Thickness: One inch.
- J. Modular Size: 48 by 96 inches (610 by 1220 mm), as indicated on the drawings.
- K. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Inherent Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.04 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: If required by authorities having jurisdiction, manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

2.05 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc; Prelude XL Heavy Duty.
 2. CertainTeed Corp.
 3. Chicago Metallic Corporation.
 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
 5. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.

2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish and Color: Painted white unless indicated otherwise on drawings.

2.06 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim for Floating Ceilings: Chicago Metallic "Infinity Perimeter Trim" painted white.
 1. Size: As indicated on Drawings.

2.07 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
 3. Acoustical sealant shall have a VOC content compliant with LEED IEQ 4.1 VOC limits.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 3. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 - 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 09 29 00.01 – “Gypsum Board” for coordination with surfaces receiving resilient base.
 - 2. Section 09 68 13.01 – “Tile Carpeting” for coordination with carpeted surfaces.

1.02 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Color Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.07 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE BASIS OF DESIGN:

- A. Locations: Where "RB" (Rubber Base) is scheduled on drawings.
- B. Resilient Base, Basis of Design:
 - 1. ROPPE CORPORATION, USA.
 - 2. Or approved substitute during the Bid Process per Instructions to Bidders and Specification Section 00 26 00.
- C. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TP (rubber, vulcanized thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- D. Minimum Thickness: 0.125 inch (3.2 mm).
- E. Height: 4 inches (102 mm) unless indicated otherwise on drawings.
- F. Lengths: Coils in manufacturer's standard length.
- G. Outside Corners: Preformed.
- H. Inside Corners: Job formed.
- I. Surface: Smooth
- J. Finish: Matte.
- K. Colors and Patterns: As indicated on the Color Schedule on the drawings. The Engineer reserves the right to change all colors, and to select from the full range of the manufacturers colors at no additional charge.

2.02 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Manufacturers: Subject to compliance with requirements, provide of the same manufacturer as the resilient base.
- B. Description: Carpet edge for glue-down applications, nosing for carpet nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips, and other accessories as shown on the drawings or as otherwise required for a complete and proper installation.
- C. Material: Rubber.
- D. Profile and Dimensions: As indicated, and as required for a complete and proper installation, and as approved by the Engineer.
- E. Colors and Patterns: As indicated on the Color Schedule on the drawings. If not shown on the drawings, color to be as most appropriate to the adjoining flooring materials, as approved by

the Engineer. The Engineer reserves the right to change all colors, and to select from the full range of the manufacturers colors at no additional charge..

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

- F. On irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 30 00.01 – “Grout and Underlayments” for slab preparation for flooring.
 - 2. Section 09 65 13.01 – “Resilient Base and Accessories” for resilient wall base and accessories installed with carpet tile.

1.02 SUMMARY

- A. Section Includes:
 - 1. Resilient Tile Flooring.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full-size units of each color and pattern of floor tile required.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
- C. Samples for Initial Selection: For each type of floor tile indicated.
- D. Welded-Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm)] Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Product Schedule: Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 86 deg F (30 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 60 deg F (16 deg C).
- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 48 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product 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."

2.02 BIO-BASED TILE

- A. Products
<<http://www.specagent.com/LookUp/?ulid=483&mf=04&mf=95&src=wd&mf=04&src=wd>>:
Subject to compliance with requirements, provide the following, or approved substitute during the bid process per Instructions to Bidders and Specification Section 00 26 00. Substitution requests shall include a physical sample for Engineers's review:
1. Armstrong BBT, "Striations".
- B. Tile Standard: ASTM F 2982.
- C. Thickness: 1/8 inch (3.175 mm).
- D. Size: 12" by 24" (305 by 610 mm)
- E. Installation: Full spread adhesives as recommended by manufacturer.
- F. Colors and Patterns: As indicated on Drawings.

2.03 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
1. Adhesives shall comply with the following limits for VOC content:
 - a. 60 g/L or less.

2. Adhesives shall comply with the testing and product 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."
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 7 or more than 10 pH.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.03 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections. Immediately remove any dropped or oozed adhesive with a damp cloth.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Cleaning to be performed after a 72 hour period following complete installation, or as recommended by manufacturer.
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply two coat(s).
- E. Cover floor tile until Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 03 30 00.01 – “Grout and Underlayments” for slab preparation for flooring.
 - 2. Section 09 65 13.01 – “Resilient Base and Accessories” for resilient wall base and accessories installed with carpet tile.

1.02 SUMMARY

- A. Section includes modular carpet tile.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

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

C. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II or Master II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.09 FLOOR PREPARATION

A. General:

1. Sub-floor preparation is to include all required work to prepare new floors for installation of the product as specified in this document. Sub-floor preparation shall meet all conditions as specified in this document. Sub-floor preparation shall meet all conditions as specified in the Manufacturer's installation instructions.
2. All materials used in sub-floor preparation and repair shall be recommended by the carpet manufacturer or shall be chemically and physically compatible with the specified carpet system.
3. Site conditions shall include those specified in the carpet manufacturers installation instructions and shall also include area heat, light and power required for effective and efficient working conditions.
4. Provide unobstructed spaces for carpet installation to include removing and replacing furniture and equipment in the installation area.

B. Sub-floors:

1. Concrete:
 - a. Concrete shall be cured, clean and dry. It shall be free of curing or parting agents that interfere with the bonding of the adhesive.
 - b. The Contractor shall submit verification that the flooring subcontractor has accepted the moisture and alkalinity condition of the slab to determine its suitability as a substrate for the material to be installed.

- c. Whenever a powdery or porous surface is encountered, a primer compatible with the adhesive shall be used to provide a suitable surface for the glue down installation.
 - d. Patching of cracks and depressions shall be made with a compatible patching compound. Do not exceed manufacturer's recommendations for patch thickness. Large patched areas must be primed.
 - 2. Primers:
 - a. The use of primers on floor surfaces is generally not necessary except for sanded, dusty, porous and acoustical surfaces. Priming cannot overcome moisture conditions and must not be used for that purpose. When used, primers must be thin and fast drying. They must be compatible with adhesives, which should be applied only after primer is dry, and must meet requirements of SCAQMD 1113.
- C. Moisture & Alkalinity in Concrete Sub-floors:
- 1. To prevent glue-down installation failures due to moisture and alkalinity, the Contractor shall be responsible for providing written moisture and alkali test results pertaining to the concrete slab prior to installation. The Contractor shall perform as many moisture and alkalinity test as are necessary to determine when the concrete floors in various portions of the building(s) are ready for carpet installation. This shall include a test at least two months in advance of the scheduled carpet installation to determine whether the concrete is curing at an adequate rate to facilitate carpet installation in accordance with the project schedule. Should the test(s) reveal the concrete has not yet reached levels of moisture and alkalinity content that are acceptable to the carpet manufacturer, the Contractor shall increase heat and outside air circulation (and take other measures as necessary) in the affected areas of the building as necessary to assist in speeding the cure rate of the concrete.
 - a. Moisture:
 - 1) At least 90 days are to be allowed for a concrete slab to cure and reach an acceptable dryness. Installation prior to 90 days shall be only with appropriate moisture test results, and the carpet manufacturer's written acceptance.
 - 2) All concrete floors should be tested to determine the moisture emission rate by utilizing a calcium chloride moisture test kit. This is a very precise test and must be conducted carefully with strict attention to the test kit manufacturer's instruction. Other test methods may be considered when acceptable to the carpet manufacturer. Various locations in the area should be tested. Moisture tests on slabs below 55o F (13o C) are not acceptable.
 - 3) Consult the carpet manufacturer to determine acceptable moisture emission rates for specific products.
 - b. Alkalinity:
 - 1) A pH range of 5-9 is satisfactory; however, a reading above 9 requires corrective measures. The pH on the surface of the concrete can be determined by slightly wetting the floor and applying pH test paper. Consult the adhesive manufacturer for recommended corrective procedures.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.
- E. Temperate & Humidity:
 - 1. Carpet shall be installed when the temperature is between 65o F and 95p F (18o C) for 48 hours prior to installation.
- F. Space Enclosure and Environmental Limitations: Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.11 WARRANTY

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

PART 2 - PRODUCTS

2.01 CARPET TILE

- A. General: Use of formaldehyde, formaldehyde by- products and 4-phenylcyclohexene in the manufacture of the carpeting material and adhesive is prohibited.
- B. Product: Basis of Design:
 - 1. MILIKEN, style "Scattergraph"
 - 2. Fiber: 100% Recycled Content Type 6,6 Nylon
 - 3. Dye Method: Millitron
 - 4. Backing: PVC-Free Underscore ES cushion
 - 5. Product Construction: Tufted. Textured Loop
 - 6. Finished Pile Thickness: .159 inch.
 - 7. Pile Height: 0.08 inch.
 - 8. Stitches Per Inch: 10.3
 - 9. Gauge: 1/8 in.
 - 10. Average Density: 8,222 Oz/Yd.

11. Size: 19.7" x 19.7" (50 cm)
 12. Protective Treatment: Protpekt.
 13. Flooring Radiant Panel: ASTM E-648, Class 1.
 14. Smoke Density: ASTM E-662 <450
 15. Electrostatic Propensity: Less than 3.5 kv.
 16. Environmental Certification: CRI Green label plus certification.
 17. Color: See Color Schedule on Drawings.
- C. Other acceptable manufacturers, subject to compliance with specifications and with substantially similar style to Basis of Design Product:
1. Shaw Carpets
 2. Interface
 3. Mohawk.

2.02 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
1. Adhesives shall comply with Green Seal (GS-36) limits.
- C. Vinyl Edge/Transition Strips: Provide transition strips of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints. Basis of Design: Roppe Vinyl Adapters and Transitions.
1. Carpet to Resilient Rubber Tile Flooring.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. With installer present, examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: With installer present, verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Installer to broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.03 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Installation Pattern: Ashlar.

3.04 CLEANING AND PROTECTION

- A. Installer shall perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
 2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
 3. Division 09 special use Sections for high-performance and special-use coatings

1.02 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior and interior substrates.
1. "Paint" as used herein means coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as primer, intermediate or finish coats, plus preparation of surfaces to receive paint.
 2. Priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
 3. Work includes painting of all interior items noted, or scheduled, for painting, unless specified under another section, plus any items not listed herein as factory finished, and any items factory primed for field painting not specified under another section, and surface preparation and priming.
 4. Work includes field painting of interior exposed bare and covered pipes and ducts, and of hangers, exposed steel and iron work, and primed metal surfaces of equipment in exposed areas installed under mechanical and electrical work, except as otherwise indicated, and except as specified under other sections.
- B. No Finish Required: Unless specifically specified otherwise, the following surfaces or categories of work are not included as part of field-applied finish work of this section:
1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) integrally colored concrete masonry, brick, toilet partitions and screens, acoustic materials, custom casework, plastic laminate surfaced wood and plywood, glass, sealant (excluding caulking as specified herein), ceramic tile, floor coverings, elevator equipment, and finished mechanical and electrical equipment including luminous ceilings, lighting fixtures, switch gear and distribution panels
 2. Exposed Finish Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, brass, bronze and similar finished materials will not require finish painting.
 3. Operating Parts: Do not paint moving parts of operating units such as valves, damper operators, sensing devices, linkage, motor and fan shafts, and similar unless otherwise indicated.
 4. Code-Required Labels: Do not paint over code-required labels, such as fire rated labels on doors and frames.

1.03 DEFINITIONS

- A. Definitions of gloss levels below are from "MPI Architectural Painting Specification Manual" (hereafter, "MPI Manual").
- B. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- F. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- H. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
 - 1. Color Sample Box: Submit one manufacturer's color box with the full line of color samples in approximately 4 x 6 inch sample size.
 - 2. Color Wheel: In addition to sample color box, submit one full spectrum color wheel for each of the various coatings involved, for Engineer's use for color selections. Submit high-performance coating colors.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Applied Finish Samples: Submit samples of each color, texture, and sheen on rigid backing, 8-1/2 inches x 11 inches. Submit 4 sets of each color and finish.
 - 2. Step down coats on Samples to show each coat required and surface prep for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area and schedule reference from Color Schedule.
 - 5. Label each Sample with the paint manufacturer's name, paint color name and number, and the specified manufacturer color name and number from the architectural drawings.
 - 6. Where directed by the Engineer, the Contractor shall provide custom colors to match the Engineer's samples, colors indicated on the Color Schedule, or as required to achieve the color desired by the Engineer.
 - 7. Additional Applied Finish Samples: Furnish additional sets of samples, in the quantities noted herein, until colors, finishes, textures are reviewed and accepted by the Engineer/Port (followed by written authorization to proceed).

8. Time: Allow ample time for submittal and resubmittal of color samples. Do no work on site until samples are approved. Samples cannot be reviewed or approved until building color samples have been provided.
- D. Product List: For each product indicated, include the following:
 1. Cross-reference in specification format to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules & specifications.
 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 3. VOC content.
- E. Qualification Data: Submit proof of compliance with all requirements of the Quality Assurance article herein.
- F. Provide Primer Finish Compatibility Certifications and sample warranty statement.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: 1 new unopened gallon of each paint color and type used on the Project.
 2. Stain: 1 new unopened gallon of each stain and type used on the project.
 3. Clear Coat: 1 new unopened gallon.

1.06 QUALITY ASSURANCE

- A. Referenced Standards:
 1. Master Painters Institute (MPI): Except as hereinafter specified, for materials and workmanship, conform to the "Architectural Painting Specification Manual" as published by the Master Painters Institute, hereinafter referred to as "MPI", as published by the following:
 - a. International:

Master Painters Institute
4090 Graveley Street
Burnaby, BC
Canada V5C 3T6
 - b. United States of American:

PDCA – Painting & Decorating Contractors of America
3913 Old Lee Highway, Suite 33-B
Fairfax, Virginia 22030-2433
703-359-0826
www.pdca.org

- c. State of Washington:
 - PDCA – Washington State Council
 - 870 SW 136th Street
 - Burien, WA. 98166
 - 206-243-7477
- 2. Consult the MPI Manual, SSPC, & MFg printed literature for surfaces not specifically mentioned in this Section.
- 3. Work in this Section may be inspected and tested by an independent inspection agency at the Port's option and expense. If the Port engages a testing agency, notify inspection agency at least ten (10) full working days prior to starting work under this Section. Allow full access to the work and give full cooperation at all times with the inspection agency in the performance of their duties of inspecting and testing the work. Painting contractor shall repair destructive testing sites.
- 4. Conform to above Manual's entire standards for "Custom" materials and work, except as otherwise indicated.
- 5. Inspection and testing fees for work of this Section shall be paid for by the Port. The Contractor, shall, however, make arrangements with the testing agency and notify them of award of contract, the amounts of the contract, and the commencement of work.
- 6. SSPC Good Painting Practices Volume 1 and 2.
- 7. Manufacturer's printed installation instructions.
- B. Regulatory Agency Requirements:
 - 1. Occupational Safety & Health and Pollution Regulations: Conform to the Federal and State requirements for painting work applicable to this project.
 - 2. Permits: Obtain and pay for permits required by local governmental agencies.
 - 3. Codes: Conform to local code requirements applicable to work of this Section.
- C. Qualifications:
 - 1. Manufacturer and Materials: Unless specified otherwise, use approved products of either the paint & stain manufactures scheduled in this Section, or one of the paint manufacturers list in the MPI – both have prior approval for manufacturers. Even if listed in MPI, a manufacturer's product is not approved for use unless it is demonstrated as fully equivalent to the specified products, with proof being provided through the submittals process. Proof of equivalency belongs to the Contractor, and the Engineer shall review acceptability.
 - 2. General Application: The firm engaged for work under this Section shall, upon request, furnish in writing his qualifications attesting to past satisfactory experience in painting work of not less than the scope of this Project.
 - a. Maintain a crew of painters throughout duration of the painting work qualified to satisfy the requirements of these Specifications.

- b. Employ qualified journeymen, in this painting work; apprentices may be employed on the project to work under the direction of qualified journeymen, in accordance with trade regulations.
- D. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- E. Coordination:
 - 1. Provide intermediate and finish coats compatible with shop primers.
 - 2. Review other sections of these specifications in which primers are provided to warrant compatibility of total coating system for various substrates. Provide certification of primer finish compatibility.
 - 3. Upon request from other trades, furnish information on specified finish materials provided for use, to certify compatible primers. Provide barrier coats over incompatible primers or notify Engineer.
- F. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Engineer will select one surface to represent surfaces and conditions for application of each paint or stain system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Engineer will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Port.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in unbroken sealed packages with manufacturer's original labels thereon, bearing manufacturer's name, type of paint or stain, brand name, color designation batch numbers and instructions for mixing and/or reducing. Do not open until Engineer review and approval.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.
- C. Take necessary precautionary measure to prevent fire hazards and spontaneous combustion; place cotton waste, cloths, and other hazardous materials in containers, and remove from site daily.

- D. Toxic, and explosive materials: Take regular appropriate safety precautions conforming to manufacturer's recommendations and applicable "Regulatory Requirements".

1.08 FIELD CONDITIONS

- A. Apply paints when surfaces and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.09 WARRANTY

- A. Installers Warranty: Two (2) years for labor and materials on installed painting systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: For specification purposes, PPG and other specific manufacturer's products are referenced. Any manufacturer listed in the MPI manual with similar, equivalent products may be used without the need to submit for a "Substitution", provided the manufacturer can furnish specified products and that they are deemed equivalent by the Engineer.
- B. Products: Subject to compliance with requirements, provide product listed in Part 3 for the paint category indicated.
- C. Material Quality:
 - 1. Provide the best quality grade of the various types of paint & stain as regularly manufactured by approved manufacturers.
 - 2. Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only to recommend limits.

2.02 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience. Provide certification of compatibility.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to current regulations.
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Non-flat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.
11. Stain: 530g/L.

D. Colors:

1. Selections: See the Color and Materials Schedule on the Drawings. The Engineer reserves the right to change colors, and select from the manufacturers full range of available colors, or to select custom colors, without additional cost.
2. Number of Colors: The number of colors will be as indicated on the Color Schedule on the Drawings. The Contractor shall allow for additional colors to be selected by the Engineer at no additional cost, provided the number of additional colors does not exceed 10 percent of the total number of original colors indicated on the Drawings.
3. Color Variations: Vary colors of succeeding coats to readily permit inspection of number of specified coats and to prevent skipping and holidays. Provide samples of intermediate color.

E. Products: See the Schedule included in Part 3 of this Section.

2.03 SOURCE QUALITY CONTROL

- A. Retain this article for large projects or critical coatings where additional control is needed. Delete if tests are not required.
- B. Testing of Paint & Stain Materials: Port reserves the right to invoke the following procedure:
 1. Port may engage the services of a qualified testing agency or inspector to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency or inspector.
 2. Testing agency or inspector will perform tests for compliance with product requirements.
 3. Port may direct Contractor to cease and desist application if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Applicator shall examine areas and conditions under which painting work is to be applied and notify Contractor and Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed until unsatisfactory conditions have been corrected in

- a manner acceptable to applicator, and surfaces approved by Engineer. Conform to the MPI, SSPC & MFg printed instruction as to surface conditions and preparations for each various surface to be painted or finished.
2. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, foreign materials or non certified shop primers.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Supplier to provide certification of primer & finish compatibility.
- E. Proceed with paint application after unsatisfactory conditions have been corrected.
1. Application of paint indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Surface Conditions:
1. Before Starting Work Under This Section: Do not proceed until defects have been corrected and surfaces are reviewed as ready to receive the work under this Section.
 2. Upon Starting Work:
 - a. Conform to Field Quality Control requirements specified hereinafter.
 - b. Starting work under this Section constitutes acceptance of surfaces by painter.
 - c. Unless otherwise specified, surfaces considered the responsibility of other trades for work under this Section include:
 - 1) Shop prime structural steel, miscellaneous metal, sheet metal, and other shop primed metal items except for minimal spot repair at field welds and surfaces abraded during their transport, storage & installation.
 - 2) The condition of substrates to be painted or finished under this Section, which may adversely affect the painting work.
- B. Comply with manufacturer's written instructions and recommendations & "MPI Manual" applicable to substrates indicated.
- C. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- D. Clean substrates of substances that could impair bond of paints & staining, including dust, dirt, oil, grease, and incompatible paints.

1. For Mildew Removal: Scrub with Jomax Mildew Cleaner solution, bleaching solution, then rinse with potable water and let thoroughly dry.
- E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and foreign materials. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 1. SSPC-SP 3, "Power Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop primer, and paint exposed areas with the same material as used for shop priming. Comply with SSPC Vol. I 7 II Good Painting Practices for spot repair of shop-primed surfaces.
- H. Aluminum Substrates: Remove oxidation.
- I. Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- K. Metal Doors and Frames: Prepare surfaces including tops, bottom and side surfaces concealed from view by abrading 100% of surface. Solvent clean per SSPC-SP-1. Exposed surfaces, including but not limited to the face, throat, edges, and stops (all sides), shall be finished as specified in this Section. Coordinate with Division 8 "Glazing" to glaze frames after painting. Provide letter of introduction to metal door & frame installer.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 1. Use applicators and techniques suited for paint & staining.
 2. Paint surfaces behind movable equipment and furniture same as similar adjacent surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match adjacent surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may omit full coat on items that are shop primed if certified by topcoat manufacturers.
- B. Workmanship, General:
 1. Highest quality consistent with trade practices, performed by skilled mechanics.

2. Sand interior surfaces between coats.
 3. Apply paint materials by method at painter's option. Spray apply finish coat on hollow metal doors and architecturally exposed steel; spread material evenly, with uniform gloss and finish and without runs or sags.
 4. Vary color of successive coats of paint to prevent skipping.
 5. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.
 6. Cut sharp lines against glass, other materials, and different colors.
 7. Allow ample time between coats for thorough drying; not less than manufacturer's recommended minimum time.
 8. Paint surfaces behind movable equipment and furniture the same as similar exposed/ adjacent surfaces.
 9. Paint the backside of access panels, and removable or hinged covers to match the exposed adjacent surfaces.
 10. Exterior primer and finishes shall not be applied when air temperature is below plus 45 degrees F.
 11. Apply block fillers and painting system to be monolithic and pin hole free.
- C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.

- d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Engineer.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Port may engage the services of a qualified testing and inspecting agency or independent inspector to inspect and test paint.
 1. If the Port engages a testing agency or inspector, notify firm and Port at least ten (10) full working days prior to starting work under this Section. Allow full access to the work and give full cooperation at all times with the inspection firm in the performance of their duties of inspecting and testing the work.
 2. Contractor shall spot repair then touch up and restore painted surfaces damaged by testing. Refinish to condition approved by Engineer.
 3. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
 4. If paint failure is due to improper surface preparation, primer application or finish coat application, remove entire system and re-apply.
- B. Testing agency / inspector or Port may:
 1. Request product invoices from manufacturer showing the product is specified in the Contract Documents.
 2. Engage services of an independent testing agency and/or laboratory, to sample paint & stain being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.
 3. Perform appropriate tests for the following characteristics: abrasion resistance, apparent reflectivity, flexibility, wash-ability, absorption, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis, and perform thickness test.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint & stain application, clean spattered surfaces. Remove spattered paints & stain by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint & stain application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

- D. Use tarpaulins or drop cloths and masking tape and paper when working above or adjacent to finished work.
- E. At completion of construction activities of other trades, spot repair and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE

- A. General: Work specified herein is in addition to primers called for under other Sections. Products listed in the following schedule are generally those of "PPG, Rodda, and Sherwin Williams" to establish the type and level of quality and paint type required. Also see article 2.1. Paint systems must conform to the MPI manual. If a paint system herein does not comply with the MPI, contact the Engineer for clarification.
- B. Hollow Metal Doors & Door Frames: Provided under Division 09 Section "High-Performance Coatings".
- C. Exterior Exposed Steel: Provided under Division 09 Section "High-Performance Coatings".
- D. Powder Coated Steel Panels , aluminum grating, and Items Noted or Scheduled to be Powder Coated:
 - 1. Surfaces to be powder coated: Exposed metal surfaces as noted.
 - 2. Substrate types: Aluminum, Cold rolled steel sheet, and stainless steel.
 - 3. Pretreatment:
 - a. Sandblast clean to near-white condition per SSPC SP10.
 - b. Remove all grit and clean using an active alkaline cleaner. Iron or zinc phosphate treatments are allowed.
 - c. Rinse thoroughly, and heat immediately to avoid surface rusting.
 - 4. Coating:
 - a. Apply coating at least 0.0025 inches thick using PPG Envirocon 04 polyester powder coating meeting AMMA 2603 or an approved super-durable polyester, urethane powder coating.
 - b. For cold-rolled steel, apply an epoxy undercoating.
- E. Mechanical, Electrical and Utility Equipment
 - 1. General: Work in this paragraph includes exposed mechanical, electrical, kitchen and utility equipment including, but not necessarily limited to, rooftop mechanical equipment, plastic gas vents, aluminum exhaust vents, rooftop pipe penetrations, exhaust fan hoods and the like.
 - 2. Primer, Ferrous Metal:
 - 3. Finish Coats: Apply two coats 2.0 to 5.0 mils DFT.

3.07 INTERIOR PAINTING SCHEDULE

- A. General
 - 1. Work specified herein is in ADDITION to primers called for under other Sections.
 - 2. Unless otherwise specifically noted on Drawings, or set forth hereinafter, interior surfaces shall be painted, or enameled and/or finished in accordance with the number and type of coats as hereinafter specified.

3. Products listed in the following schedule are generally those of "PPG, Rodda, Sherwin Williams." See article 2.1 for other manufacturer's products and substitutions.

B. Gloss and Sheen Levels

1. Conform to Gloss and Sheen Levels as tested in accordance with ASTM D523. Regardless of that stated by manufacturer product data shown on paint containers.

Gloss and Sheen Levels		Gloss @ 60 Degrees	Sheen @ 85 Degrees
Gloss Level 1	Matt or Flatt	Max 5 units	Max 10 units
Gloss Level 2	Low Sheen	Max 10 units	10 to 35 units
Gloss Level 3	Eggshell	10 to 25 units	10 to 35 units
Gloss Level 4	Satin	20 to 35 units	Min 35 units
Gloss Level 5	Semi-Gloss	35 to 70 units	(N/A)
Gloss Level 6	Gloss	70 to 85 units	(N/A)
Gloss Level 7	High Gloss	More than 85 units	(N/A)

C. Finishes and Colors

1. Field Painting Product Systems and Gloss Levels: As Scheduled this section.
2. Paint Colors: Listing of paint manufacturer's color does not constitute acceptance of paint manufactured or product.
3. Gloss and Sheen Levels: As scheduled this Section, and as follows for gypsum board finishes.
 - a. Ceiling: Low sheen
 - b. Walls: Eggshell
 - c. Wet Areas (restrooms, janitorial): Semi-Gloss

D. Gypsum Wallboard:

1. Where "GWB" is Scheduled:
 - a. One coat "PPG SPEEDHIDE INTERIOR HIGH BUILD LATEX PRIMER SEALER 6-4", 4.0 mils WFT
 - b. Two coats "PPG PURE PERFORMANCE" Interior Latex 9-300 Series (4.0 to 4.6 mils wet, 1.5 to 1.8 mils dry per coat).

E. Hollow Metal Relite Frames, Doors & Door Frames, Access Doors, and Metal Frames at Wood Door Lites: See Section 09 96 00.01 "High-Performance Coatings".

F. Interior Exposed Steel: Interior exposed steel.

1. Provided under Section 09 96 00.01 "High-Performance Coatings".

G. Powder Coated Steel Panels and Other Items Noted or Scheduled to be Powder Coated:

1. Surfaces to be painted: Exposed surfaces and as indicated, including face, edges, and inside surfaces of perforations.
2. Pretreatment:
 - a. Sandblast clean to near-white condition per SSPC SP10.
 - b. Remove all grit and clean using an active alkaline cleaner. Iron or Zinc phosphate treatments are allowed.
 - c. Rinse thoroughly, and heat immediately to avoid surface rusting.
3. Coating:
 - a. Apply an epoxy undercoating.
 - b. Apply coating at least 0.0025 inches thick using PPG Envirocon 04 polyester powder coating meeting AMMA 2603 or an approved polyester, or TGIC polyester powder coating, as is most suitable for application intended service.

H. Mechanical Equipment, Grilles & Diffusers

1. Inside ducts just behind grilles and diffusers: Paint to 12 inches back from grilles, one coat dead black flat, same system as specified for interior hollow-metal doors.
2. Exposed Pipes: Paint exposed pipes in occupied and otherwise public areas with finish system as specified herein for Interior Exposed Steel, except no painting required in Mechanical rooms and spaces.
3. Ducts Exposed in occupied spaces: Paint exposed ducts in occupied and otherwise public areas only where specifically noted for a painted finish, with finish system as specified herein for Interior Steel, color as selected. No painting required in Mechanical rooms and spaces except where visible at Mechanical platforms.
4. All other mechanical equipment: Surfaces are factory-finished; no painting or finishing required.
5. Mechanical grilles and diffusers located in walls with accent paint: Paint to match wall using products specified for use at interior hollow metal doors and frames.

I. Electrical Equipment

1. Flush Distribution Panels in Finish-Painted Walls: Paint with same system as specified above for interior hollow metal doors and frames, of same finish color as adjacent wall.
2. Surface Mounted Panels: Unless otherwise directed by the Port, paint with same system as specified above, of same finish color as adjacent wall.
3. Conduit: No painting required in Electrical, Mechanical and attic rooms and spaces. At other locations, paint exposed conduit in areas with finish system as specified herein for Interior Exposed Steel color as indicated in Color and Materials Schedule.

3.08 EXTERIOR FINISH SCHEDULE

A. General:

1. Work specified herein is in addition to shop coats called for under other Sections. Products listed in the following schedule are generally those of "PPG" to establish the type and level of quality and paint type required. Also see article 2.1. Paint systems must conform to the MPI manual. If a paint system herein does not comply with the MPI, contact the Engineer for clarification.

B. Hollow Metal Doors & Door Frames:

1. Surfaces to be Painted: Include exposed surfaces - both faces, ends, edges and stops (all sides) of exterior hollow metal doors and exposed frame surfaces. Coordinate with Section 08 80 00.01 to glaze after coating. Provide glazing contractor with submittal.

C. Exterior Exposed Steel:

1. Provided under Section 09 96 00.01 "High-Performance Coatings".

D. Wood Trim noted or scheduled to be painted (not stained):

1. Surfaces to be Painted: Include exposed surfaces - both faces, ends, edges and stops (all sides) of wood trim. Prime prior to installation.
2. Primer and finish coats may be applied by either spray or roller or brush application; if primer is spray applied, back-brush to provide maximum penetration.
3. Sealer / Primer for Cedar: Where paint is to be applied over previously unpainted cedar, provide the paint manufacturer's recommended sealer/primer to prevent cedar bleeding.
4. Prime Coat:
 - a. PPG Speedhide Exterior Acrylic Primer 6-609.
 - b. S-W Premium Interior Wall & Wood Primer, B28W08111.
5. Two Finish Coats
 - a. PPG Speedhide Exterior Acrylic 6-2045.
 - b. S-W A-100 Exterior Latex Satin, A82 Series.

E. Mechanical, Electrical and Utility Equipment Scheduled or noted to be painted:

1. General: Work in this paragraph includes exposed mechanical, electrical, utility equipment including, but not necessarily limited to, rooftop mechanical equipment, plastic gas vents, aluminum exhaust vents, rooftop pipe penetrations, exhaust fan hoods and the like, which are scheduled or noted to be painted.
2. Clean and prepare surfaces to receive painting in accordance SSPC SP-1.
3. Prime Coat:
 - a. PPG 90-96 Aquapon WB Primer.
 - b. S-W Multi-Purpose Pro-cryl.
4. Two Finish Coats:
 - a. PPG: 90-812 Pitt Tech EDF
 - b. S-W: Sher-cryl.
 - c. Rodda: Metal Master.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Division 05 Sections for shop priming of metal substrates.
 - 2. Division 09 "Painting" Section for general field painting.

1.02 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems on the substrates indicated.

1.03 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include surface preparation requirements, application and cure instructions.
- B. Samples: Provide for each type of topcoat product indicated. Samples will not be returned other than copies of approved sample finishes (draw-downs):
 - 1. Color Sample Box: If requested by the Engineer, submit one manufacture's color box with the full line of color samples in approximately 4 x 6 inch sample size.
 - 2. Color Wheel: If requested by the Engineer, submit one full spectrum color wheel for each of the various coatings involved, for Engineer's use for color selections; submit additional color wheels or the like for specialty coatings of other manufactures where different from general paint supplier.
 - 3. Applied Finish Samples: Submit samples in accordance with the following as directed:
 - a. Where requested, and before commencing work, prepare samples on final substrate; size not less than 12" x 12".
 - b. Prepare (4) sets of 8 ½" x 11" paint sample cards of each color, texture, and sheen.
 - c. Furnish additional required samples until colors, finishes, textures are reviewed and accepted by the Engineer (followed by written authorization to proceed).
 - d. Mark on each sample the coating manufacturer's name, color name, and color code formula.
 - e. Allow ample time for the selection of colors; do not work until colors are approved.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineers and Ports, and other information specified.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. VOC content.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.06 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Engineer will select one surface to represent surfaces and conditions for application of each coating system specified.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Engineer will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. See Quality Assurance requirements of Division 9 Section "Painting" which also applies to this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.08 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Tnemec is used in this specification as the basis of design. Other manufacturers, with equivalent products meeting or exceeding specifications, may submit substitution requests provided in Instructions to Bidders specification section 00 26 00.
- B. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the coating category indicated.

2.02 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.
4. Where the shop primer is not compatible with the specified field applied primer and/or finish coats, notify Architect.

B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to current rules and regulations.

1. Flat Paints and Coatings: 50 g/L.
2. Non-flat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Mio/Zinc Primer: 250 g/L.

C. Colors: As selected by Engineer from manufacturer's full range, or custom colors where requested by Engineer. Also see Color Schedule on drawings.

2.03 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

A. Ferrous Metal:

1. Locations: All exterior ferrous metal.
 - a. Exposed structural steel (of all types).
 - b. Steel pipe bollards.
 - c. Steel railings.
 - d. Other miscellaneous exposed steel noted or scheduled to be coated. See Color Schedule on the drawings.
2. Finish:
 - a. Primer: This coat may be shop applied and spot repaired in the field. Coordinate with Division 5 Sections.
 - 1) "Tnemec Series 394-250 PerimePrime, 2.5 to 3.5 mils DFT.
 - b. Intermediate Coat:
 - 1) "FC 27 Typoxy, 3.0 to 5.0 mils DFT.
 - c. Color Coat:
 - 1) "TNEMEC Series 750 UVX, 3.0 to 5.0 mils DFT.

B. Nonferrous Metal: Provide the following finish systems over exterior nonferrous-metal surfaces scheduled or noted to be painted:

1. Primer: This coat may be factory applied and spot repaired in the field. Coordinate with Division 05 Sections.
 - a. "TNEMEC Series FC27 Typoxy, 2 to 3.5 mils DFT.
 2. Color Coat: Tnemec Series 750 UVX, 2.0 to 3.0 mils DFT.
- C. Hollow Metal Doors & Door Frames:
1. Primed Surfaces: As specified in Division 08 Section "Hollow Metal Doors and Frames".
 2. Surfaces to be /coated: Include exposed surfaces - both faces, ends, edges and stops (all sides) of all exterior hollow metal doors and exposed frame surfaces. .
 3. Field Prime Coat: "TNEMEC Series FC 27 Typoxy", 2 to 3 mils dry film thickness. Apply to all exposed surfaces.
 4. Field Finish Coat: "TNEMEC Series 750 UVX", 2 to 3 mils dry film thickness, or, Apply to all exposed surfaces.

2.04 INTERIOR HIGH-PERFORMANCE COATING SYSTEMS

- A. Hollow Metal Doors and Hollow Metal Frames: Same as exterior.
- B. Ferrous Metal
1. Locations: All interior ferrous metal, including but not limited to (do not paint stainless steel unless specifically noted):
 - a. Exposed structural steel (of all types).
 - b. Decorative steel
 - c. Other miscellaneous exposed steel.
 2. Finish:
 - a. Primer: This coat may be factory applied and spot repaired in the field. Coordinate with Division 5 Sections.
 - 1) "TNEMEC Series 394-250 PerimePrime", 2.5 to 3.5 mils DFT.
 - b. Intermediate Coat:
 - 1) "TNEMEC Series 115 Uni-Bond DF, 2.0 to 4.0 mils DFT.
 - c. Color Coat:
 - 1) "TNEMEC Series 1029 Enduratone, 2.0 to 3.0 mils DFT.
- C. Nonferrous Metal: Where scheduled to be coated, provide same as above for ferrous metal. Confirm any special priming requirements with manufacturer and provide.
- D. Metal Relite Frames, Doors & Door Frames, Access Doors, and Metal Frames at Wood Door Lites: Same as specified for exterior hollow metal doors and frames.

2.05 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Port reserves the right to invoke the following procedure:
1. Port will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.
3. Port may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Certify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Provide primer finish certification of compatibility from finish coat supplier.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "SSPC Good Painting Practice" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 1. SSPC-SP 11, "Mechanical Preparations to Achieve Commercial Blast Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop primer, exposed areas with the same material as used for shop priming to comply with SSPC Vol I&II Good Painting Practices for spot repair and touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings. Clean galvanized metal in accordance with ASTM D 6386.
- G. Aluminum Substrates: Remove loose surface oxidation. Abrade 100% of surface to be painted with 3M Brown metal finish pad.

3.03 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions, this specification section, and recommendations in SSPC Vol.1 & II.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. System used shall be at the Contractor's discretion as necessary to produce the highest quality finish, unless a specific system is specified herein.
 - 3. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 4. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 5. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Omit primer on metal surfaces that have been shop primed and touchup painted, if specifically allowed herein.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Port may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall spot repair and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, spot repair and restore damaged or defaced coated surfaces.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Division 22 Sections for labels, tags, and nameplates for plumbing systems and equipment.
 - 2. Division 23 Sections for labels, tags, and nameplates for HVAC systems and equipment.
 - 3. Division 26 Sections for labels, tags, and nameplates for electrical equipment.
 - 4. Division 26 Sections for illuminated Exit signs.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Dimensional characters.
 - 2. Panel signs.
 - 3. Signage accessories.

1.03 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, and graphic elements, including tactile characters, Braille, and layout for each sign.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Aluminum.
 - 2. Acrylic sheet.
 - 3. Polycarbonate sheet.
 - 4. Fiberglass sheet.
 - 5. Die-cut vinyl characters and graphic symbols. Include representative samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Panel Signs: 8 inches (150 mm) square including all components, materials, and border.

2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter, number, and graphic element).
3. Aluminum: For each form, finish, and color, on 6-inch- (150-mm-) long sections of extrusions and squares of sheet at least 4 by 4 inches (100 by 100 mm).
4. Acrylic Sheet: 8 by 10 inches (200 by 250 mm) for each color required.
5. Back-Printed Acrylic: 8 x 10 inches with sample printed graphic.
6. Panel Signs: Not less than 12 inches (305 mm) square.
7. Accessories: Manufacturer's full-size unit.

E. Sign Schedule: Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Warranty: Special warranty specified in this Section.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- C. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 current addition.
 1. Interior Code Signage: Provide signage to meet requirements of accessibility regulations, and requirements of authorities having jurisdiction.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- C. Text Information Supplied by Port (For all Signage): Copy/ text noted herein to be supplied by Port during shop drawing process, Contractor shall provide Port minimum 60 days advanced notice of when such information will be needed.

1.09 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
2. Warranty Period: Five (5) years.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), 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.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), 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 6063-T5.
- D. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- E. Plaque Schedule: See Sign Schedule on Drawings.

2.02 DIMENSIONAL CHARACTERS

- A. Manufacturers: Subject to compliance with requirements, provide signage by manufacturers meeting or exceeding all specifications.
- B. Locations: For use at building interior and exterior, as indicated on Drawings.
- C. Cutout Characters: Provide characters with square-cut, smooth edges. Comply with the following requirements:
 1. Aluminum Sheet: 0.25 inch (6.35 mm) thick.
 - a. Finish: Painted.
 - b. Color: As noted on color and material schedule and signage details.
 2. Mounting: Adhesive Projected with concealed noncorroding studs, as indicated on Drawings for substrates encountered.
- D. Dimensional Character Sign Schedule: See Sign Schedule on Drawings.

2.03 PANEL SIGNS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Vertical Visual Solutions.
 2. Graphic Systems APCO Northwest.
 3. Bunting Graphics, Inc.

4. Media Inc., Kent, WA.
 5. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- D. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
1. Frosted Acrylic: 0.125 inches thick. P95 Frosted Acrylic.
 2. Clear Acrylic with Subsurface Digital Print: 0.125 inches thick. P99 non-glare acrylic.
 3. Colored Acrylic: 0.125 inches thick. P95 colored acrylic. Color to be chosen by Engineer from manufacturer's full range of colors.
 4. Edge Condition: Square cut.
 5. Corner Condition: Square.
 6. Mounting: Unframed.
 - a. Wall mounted with two-face tape.
 - b. Manufacturer's standard anchors for substrates encountered.
 7. Fasteners: "Snake Eyes," tamper-proof stainless steel fasteners.
 8. Color: As selected by Engineer from manufacturer's full range.
 9. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.
- E. Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner, complying with the following requirements:
1. Frosted Acrylic: 0.125 inches thick. P95 Frosted Acrylic with subsurface paint. Engineer to select from Manufacturer's full range of colors.
 2. Colored Acrylic: 0.125 inches thick. P95 Colored Acrylic. Engineer to select from manufacturer's full range of colors.
 3. Edge Condition: Square cut
 4. Corner Condition: Square.
 5. Mounting: Unframed.
 - a. Wall mounted.
 - b. Manufacturer's standard non-corroding anchors for substrates encountered.
 6. Custom Paint Colors: Match Pantone color matching system.
 7. Color: As selected by Engineer from manufacturer's full range.
- F. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Port.
1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Port production of paper inserts.
 2. Furnish insert material cut-to-size for changeable message insert.

- G. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Panel Material: Acrylic sheet.
 - 2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).
- H. Panel Sign Schedule: See Sign Schedule on Drawings.
 - 1. Sign Type:

2.04 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.05 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.06 FINISHES, GENERAL

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

2.07 ALUMINUM FINISHES

- A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

2.08 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

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 work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Interior Wall Signs: Install signs on walls where indicated, typically adjacent to latch side of door where applicable, unless indicated otherwise. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Panel Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply. Attach panel signs to wall surfaces using methods indicated below:
 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 3. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
 4. High Bond Epoxy Mounting: Attach signs to exterior siding materials. Two-face tape may also be used for mounting while epoxy cures.

3.03 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Port.

3.04 SIGN SCHEDULE

- A. See drawing sheets.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 05 50 00.01 – “Metal Fabrications” for supports that attach floor-and-ceiling-anchored compartments and post-to-ceiling screens to overhead structural system.
 - 2. Section 10 28 00.01 – “Toilet, Bath, and Laundry Accessories” for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.02 SUMMARY

- A. Section Includes:
 - 1. Solid plastic toilet compartments and urinal screens.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.

1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible, and the requirements of the agency having jurisdiction.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. High Density Polyethylene (HDPE), fabricated from polymer resins compounded under high pressure, forming single thickness panel.
 - 1. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
 - 2. 1 inch thick with edges rounded to ¼ inch radius.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless-Steel Castings: ASTM A 743/A 743M.

2.02 HIGH DENSITY POLYETHYLENE (HDPE) UNITS

- A. Manufacturers: Subject to compliance with requirements, provide Scranton products or comparable product.
- B. Toilet-Enclosure Style: Overhead braced, floor supported.
 - 1. Basis of Design: Scranton Products "Hiney Hiders".
- C. Urinal-Screen Style: Wall hung, floor supported.
 - 1. Basis of Design: Scranton Products "Hiney Hiders".
 - 2. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- D. Door, Panel, Screen, and Pilaster Construction: High Density Polyethylene.
 - 1. Fabricated from polymer resins compounded under high pressure, forming single thickness panel.
 - 2. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments
 - 3. Edge: 1 inch thick with edges rounded to ¼ inch radius.
 - 4. Panels and Doors: 55 inches high, mounted 14 inches above finished floor, with aluminum heat-sinc fastened to bottom edges. 1 inch thick, constructed from HDP.
 - 5. Recycled Content: Minimum 25%.
- E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than 1-1/4-inch nominal thickness from 22 gauge stainless steel and 3 inches (76 mm) high, finished to match hardware.

- F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.
- G. Headrail: Heavy-duty extruded aluminum, anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant Torx head sex bolt and at top of pilaster with stainless steel tamper resistant Torx head screws.
- H. Headrail Brackets: 20 gage stainless steel, satin finish, secured to wall with stainless steel tamper resistant Torx head screws.

2.03 ACCESSORIES

- A. Hardware and Accessories: Scranton Products Stealth Hardware Collection.
 - 1. Material: Chrome.
 - 2. Hinges: Stealth integral hinge from door and pilaster material with exposed metal parts on interior of stall.
 - 3. Latch and Housing: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - a. Heavy-duty extruded aluminum.
 - b. Latch housing: Bright dip anodized finish.
 - c. Slide bolt and button: Black anodized finish.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - a. Combination type, chrome plated Zamak.
 - b. Equip outswing handicapped doors with second door pull and door stop.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard Chrome plated Zamak unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Floor Bracing: Manufacturer's stainless steel floor attachment and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel.

2.04 FABRICATION

- A. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- B. Urinal-Screen: Provide manufacturer's standard corrosion-resistant wall anchoring assemblies.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging (unless indicated otherwise) doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.02 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Corner guards.

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.
 - 1. Corner Guards: 12 inches (300 mm) long.

1.04 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.06 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 240/A 240M.

- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content meeting SCAQMD Rule 1168 Standards.

2.02 CORNER GUARDS

- A. Surface-Mounted, Stainless Steel Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Material: Stainless-steel sheet, Type 304.
 - a. Thickness: Minimum 0.0500 inch (1.3 mm)
 - b. Finish: Directional satin, No. 4.
 - 2. Quantity: 8
 - 3. Location: To be determined during construction
 - 4. Height: 5'-0"
 - 5. Wing Size: Nominal 2-1/2 by 2-1/2 inches (65 by 65 mm)
 - 6. Corner Radius: 1/8 inch (3 mm)
 - 7. Mounting: [Flat-head, countersunk screws through factory-drilled mounting holes Oval head, countersunk screws through factory-drilled mounting holes] Adhesive.
 - 8. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. IPC DOOR AND WALL PROTECTION SYSTEMS; Division of InPro Corporation, or equal.

2.03 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- D. Miter corners and ends of wood handrails for returns.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.03 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings, and as required in this section.
 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
 - a. Provide anchoring devices to withstand imposed loads.
 - b. Adjust caps as required to ensure tight seams.

3.04 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Division 22 Sections for Underlavatory guards.

1.02 SUMMARY

- A. Section Includes:
 - 1. Washroom accessories.
- B. Port-Furnished Material: As noted in this Section.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.07 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.08 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 WASHROOM ACCESSORIES

- A. Basis-of-Design Product: BOBRICK
1. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Toilet Tissue (Roll) Dispenser (TPD) for single occupant restrooms:
1. Basis-of-Design Product: Bobrick model B-2888 (in stalls); B-3888 (unisex).
2. Description: Double-roll dispenser.
3. Mounting: Recessed.
4. Operation: As is standard for basis-of-design product.
5. Capacity: Designed for 5-inch- (127-mm-) diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Electric Hand Dryers (EHD)
1. Basis of Design product: WORLD DRYER – SMARTDRI # K-973
2. Mounting: Surface mounted, 10 second dry speed, energy efficient
3. Material: Stainless steel, No 4 finish (satin)
4. One per restroom
- D. Liquid-Soap Dispenser (SD):

1. Basis-of-Design Product: BOBRICK model B-2111, wall-mounted soap dispenser.
 2. Description: Designed for dispensing soap in liquid form.
 3. Mounting: Wall mounted.
 4. Capacity: 1200 mL.
 5. Color: Stainless steel, No. 4 finish (satin).
 6. Refill Indicator: Window type.
- E. Grab Bar (GB):
1. Basis-of-Design Product: BOBRICK model B-6806 for straight bars and model B-68137.99 for "L" shaped bars, except provide in sizes indicated on the drawings. Stainless steel grab bars with snap flange.
 2. Mounting: Flanges with exposed fasteners.
 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 4. Outside Diameter: 1-1/2 inches (38 mm).
 5. Configuration and Length: As indicated on Drawings.
- F. Feminine -Napkin Disposal Unit (FND):
1. Basis-of-Design Product: BOBRICK model B-282-25 "ClassicSeries" surface-mounted sanitary napkin disposal.
 2. Mounting: Surface mounted.
 3. Door or Cover: Self-closing, disposal-opening cover.
 4. Receptacle: Removable.
 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- G. Toilet Seat-Cover Dispenser (TSCD):
1. Basis-of-Design Product: BOBRICK model B-221 surfaced-mounted seat-cover dispenser.
 2. Mounting: Surface mounted.
 3. Minimum Capacity: 250 seat covers.
 4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
 5. Lockset: Tumbler type.
- H. Mirror Unit without Shelf (all locations where a mirror is shown, unless noted otherwise):
1. Basis-of-Design Product: BOBRICK model B-290 2436 and B290 2472, glass mirror with stainless steel angle frame.
 2. Frame: Stainless-steel channel.
 - a. Corners: Manufacturer's standard.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

- a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.
- I. Robe Hook (RH):
 1. Basis-of-Design Product: BOBRICK model B-682, surface-mounted hat and coat hook.
 2. Description: Double-flange unit.
 3. Material and Finish: Stainless steel, bright polished.
 4. One (1) per each unisex toilet room; one (1) per stall.
- J. Paper Towel Dispenser (PTD):
 1. Basis of Design Product: BOBRICK model B3944 ClassicSeries Recessed Convertible Paper Towel Dispenser / Waste Receptacle, with 3944-134 LinerMate. BOBRICK model B-4262 with liner mate when located above counter tops.
 2. Description: Convertible folded paper towel dispenser and 12 gallon waste receptacle, with liner.
 - a. Dispenses C-fold or Multi-fold towels.
 - b. LinerMate to rest inside waste receptacle to facilitate installation and removal of disposable liners.
 3. Material and Finish: Satin-finish stainless steel.
 4. One (1) per each toilet room.
 5. Bobrick model B-4262 with liner mate when located above counter tops.

2.03 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide BOBRICK product indicated on Drawings or comparable product by one of the following:
 1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bradley Corporation.
 4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 5. Tubular Specialties Manufacturing, Inc.
- B. Mop and Broom Holder:
 1. Basis-of-Design Product: BOBRICK model B-239, utility shelf with mop/broom holders and rag hooks.
 2. Description: Unit with shelf, hooks and holders.
 3. Length: 34 inches (865 mm).
 4. Hooks: Four.
 5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.

- 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

2.04 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 10 14 00.01 – “Signage” for signage at fire extinguisher cabinets and for directional signage to out-of-sight fire extinguishers and cabinets.
 - 2. Section 10 44 16.01 – “Fire Extinguishers.”

1.02 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

1.03 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, finish, trim style, and panel style.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Samples for Initial Selection: For each type of exposed finish required.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.
- F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.05 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.07 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LARSEN Model 2409 at non-fire rated walls, and Model FS2409 at fire rated walls, "Vertical Duo" design or comparable product by one of the following:
 - a. Guardian Fire Equipment, Inc.
 - b. Larsens Manufacturing Company.
- B. Cabinet Construction: Fire rated at fire rated walls, and non-rated at non-fire rated walls.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Aluminum sheet.
- D. Semirecessed Cabinet: Provide semi-recessed unless indicated otherwise on Drawings, cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated. One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Rolled-Edge Trim: Backbend depth as dictated by wall depth available. Provide maximum recess possible given wall depth.
- E. Surface-Mounted Cabinet: Where indicated on Drawings, cabinet box fully exposed and mounted directly on wall with no trim. Provide where walls are of insufficient depth for semi-recessed cabinet installation.
- F. Cabinet Trim Material: Same material and finish as door.
- G. Door Material: Aluminum sheet.
- H. Door Style: As indicated by Basis of Design.
- I. Door Glazing: Tempered.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide As indicated by Basis of Design selection in manufacturer's standard.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Engraved or Etched.
 - 3) Lettering Color: White.
 - 4) Orientation: Manufacturer's standard, unless required otherwise by agency having jurisdiction.

L. Finishes:

1. Aluminum: Clear anodic.

2.02 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.03 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.04 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Examine walls and partitions to ensure gypsum board is installed in cabinet recess as detailed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to [structure,][wall / framing] square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semi-recessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 10 44 13.01 – “Fire Extinguisher Cabinets.”

1.02 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

1.04 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.07 COORDINATION

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

1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years.

PART 2 - PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and each mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
 1. For use at all locations and quantities as shown on the drawings.

2.02 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 2. For use at all locations and quantities as shown on the drawings where a fire extinguisher cabinet is not shown, or FEB (Fire Extinguisher and Bracket) is indicated.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.
 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher, unless indicated otherwise on the drawings or unless a different height is required by the agency having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 05 50 00.01 – “Metal Fabrications” for requirements for steel components associated with custom casework specified herein. Provide steel components required for custom casework under this section. Comply with material and fabrication requirements of Division 05 “Metal Fabrications”.
 2. Section 08 71 00.01 – “Door Hardware” for lock cylinders to be furnished for installation under this Section.
 3. Section 08 80 00.01 – “Glazing” for back-painted glass back splashes.
 4. Section 09 65 13.01 – “Resilient Base and Accessories” for resilient base applied to manufactured wood casework.
 5. Section 09 91 23.01 – “Painting” for field finishing of installed interior architectural woodwork.
 6. Division 22 through 27 Sections for Rough-in for furnishing and installation of, and connections to, mechanical and electrical fixtures and fittings to be built into casework covered under Mechanical and Electrical Work Contracts, as applicable, respectively

1.02 SUMMARY

- A. Section Includes:
1. Casework Scope: Casework of this section provides for all casework for this project, unless specifically noted otherwise in other sections.
 2. Casework Types: Furnish and install, custom and standard, complete in place except as hereinafter set forth, factory-fabricated, assembled and finished plastic-laminate faced, wood veneer faced and custom wood fixed casework (cabinets), mobile casework, book shelves, utility shelving, and other special items described herein, all as shown on the Drawings.
 3. Plastic Laminate Countertops and Backsplashes and Other Related Items: This Section includes all plastic laminate faced countertops and back splashes, plastic laminate wainscots, and other similar plastic laminate applications, unless specifically noted for inclusion under another Section. Countertops shall be assumed to be provided at all base cabinets under 72 inches above finished floor, whether shown or called out or not. Unless noted otherwise, these tops shall be assumed to have a plastic laminate finish. Where called out, or where graphically depicted (even if not called out), provide a back splash and end return back splashes, finished the same as the countertop. Unless noted otherwise, back splashes shall be 4 inches high, and shall be adhered to a $\frac{3}{4}$ inch thick backing material, as specified herein. Unless noted otherwise, countertops shall be provided for restroom and other sink locations shown without base cabinets, whether called out or not, except where wall hung lavatories are used. These countertops shall be provided with painted steel support brackets as required to properly support the counter and to provide handicapped accessible knee space.
 4. Other Countertops and Backsplashes: This section also includes countertops and backsplashes in addition to plastic laminate, such as solid-surfacing, as specified herein.

5. Referenced Standards: Casework items shall meet or exceed the standard of construction and material quality set forth in the references AWI standards, and shall also meet or exceed Westmark's commercial casework specifications, except where specific construction and material requirements are specified under Article 2.00 of this Section or in "Notes to Casework Schedule and Details" or on the drawings which modify said standard published specifications. Casework shall meet or exceed the specific construction and material requirements specified.
6. Casework Modifications: Manufacturers shall alter their casework as necessary to suit building dimensions, and to suit equipment to be installed adjacent thereto.

1.03 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. Exposed Portions of Cabinets:
 1. Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets.
 2. Interiors of open cabinets.
 3. Cabinet tops under 72" above finish floor, or over 72" above finish floor if visible from an upper building level.
 4. Visible edges of cabinet ends, doors and drawer fronts.
 5. Visible surfaces behind glass doors.
 6. Sloping tops of cabinets that are visible.
- C. Semi-exposed Portions of Cabinets:
 1. Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semi-exposed.
 2. All surfaces visible when doors and drawers are open including interior faces of hinged doors.
 3. The underside bottoms of wall hung cabinets, where bottom is below 4 feet above finished floor.
 4. Visible portions of bottoms, tops and ends in front of sliding doors in closed position.
- D. Concealed Portions of Cabinets:
 1. Surfaces not usually visible after installation, including sleepers, stretchers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.
 2. Toe space unless otherwise specified.
 3. Security panels.
 4. Underside of bottoms of cabinets less than 30 inches above the finished floor.
 5. Flat tops of cabinets over 78 inches above the finished floor, except if visible from an upper building level.
 6. The three non-visible edges of adjustable shelves.
 7. The underside of countertops, knee spaces (except visible side panels or cabinets), and drawer aprons.

8. The faces of cabinet ends of adjoining units that butt together.

- E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including as aspect of casework and hardware.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
 2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
 3. Show location(s) of each item, dimensioned plans and elevations, large scale details, attachment devices and other components. Locate sink centerlines for guidance of other trades.
- C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.
1. Shop-applied transparent finishes.
 2. Shop-applied opaque finishes.
 3. Plastic laminates.
 4. Thermoset decorative overlays.
 5. Solid surfacing materials.
 6. Edging materials.
 7. Hardware finishes.
 8. In addition to samples for standard finish components, provide samples of powder coating for both quality and colors. Repeat sample submittal process until color and finish are acceptable to the Engineer.
- D. Samples for Verification: 8-by-10-inch (200-by-250-mm) Samples for each type of finish, including top material and the following:
1. Section of countertop showing top, front edge, and backsplash construction.
 2. Full sized base cabinet, 24 inches wide, with cabinet drawer, door, adjustable shelf, hardware, and countertop, illustrating compliance with these specifications.
- E. Keying Schedule
1. Product certificates signed by woodwork fabricator certifying that products comply with specified requirements.
 2. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineers and Ports, and other information specified.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Fabricator/Manufacturer and Installer.
- B. Warranty: Sample of special warranty.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
 - 2. Firm experienced in producing architectural casework similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work. Firm shall have successfully completed a minimum of 10 projects of similar size, type, and schedule in the last two years, and provide evidence, satisfactory to the Engineer, of such.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Source Limitations: Obtain manufactured wood casework from single source from single manufacturer.
- D. Single-Source Responsibility for Fabrication and Installation: Engage a qualified casework manufacturer to assume undivided responsibility for fabricating, finishing, and installing casework specified in this Section.
- E. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
 - 1. Provide AWI Quality Certification Program certificate indicating that manufactured wood casework complies with requirements.
 - 2. The Contract Documents contain selections chosen from options in the Quality Standard as well as additional requirements beyond those of the Quality Standard. Comply with such selections and requirements in addition to the Quality Standard.
- F. Reference Standard: All Materials shall conform to these requirements:
 - 1. Decorative, High Pressure Plastic Laminates: NEMA LD-3 (National Electrical Manufacturers Association).
 - a. Horizontal Grade .050" = GP50.
 - b. Postforming grade .042" = PF42.
 - c. Vertical Grade .028 = VG28.
 - d. Cabinet Linear Grade .020 = CL20. Low Pressure Thermofused Polyester and Melamine Laminates: ALA (American Laminators Association).
 - 2. PVC Edgebanding: (polyvinyl chloride) on seamless rolls to be applied with automatic edge banding machines using hot-melt adhesives. Product to be chip proof, flame and moisture resistant.

3. Particleboard: ANSI 208.1 (American National Standards Institute).
 4. Softwood Plywood: U.S. Product Standards PS1.
 5. Hardwood Plywood: ANSI HPVA (Hardwood Plywood & Veneer Association).
 6. Hardboard: ANSI AHA 135.484 (American Hardboard Association).
 7. PVA Adhesive: (polyvinyl acetate) White glue, Type III ASTM D3110 (American Society for Testing and Materials).
 8. Aliphatic Adhesive: (carpenters glue) Type II ASTM D3110 (American Society for Testing and Materials).
 9. Solvent Based Contact Cement MMM-A-J1330B.
 10. Workmanship: Comply with industry standards AWI (Architectural Woodwork Institute) and WIC (Woodwork Institute of California).
- G. Casework Mock-Ups: Provide casework mock-ups as follows. Mock-ups may become a part of the finished installation if approved by the Engineer.
1. Custom Cabinet with Wood Stripping: Provide at least one full-sized section of casework, including base and upper cabinet sections, countertop, and at least one drawer with wood stripping facing. Show complete and final finished cabinet including all finishes, hardware and accessories.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings 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.
- B. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.
- C. Environmental Limitations: Obtain and comply with casework fabricator's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install casework until these conditions have been attained and stabilized so that woodwork will be within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.
- B. Hardware Coordination: Distribute copies of approved schedule for cabinet hardware specified in Division 08 Section "Door Hardware" to fabricator of architectural casework; coordinate cabinet shop drawings and fabrication with hardware requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's warrants that all casework materials and workmanship conform to project specifications and industry standards, and in which Manufacturer agrees to repair or replace, at no cost to the Port, components of manufactured wood casework that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - d. Deterioration of finishes.
 2. Warranty Period: One year.
 3. Variations from Referenced Standards: The warranty shall covered all products specified herein, even if they vary from the referenced standards, including but not limited to plastic laminate faced plywood core doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Casework: The following architectural casework manufacturers are approved, subject to conformance with the Contract Documents, provided that overall dimensions shown are adhered to and no filler (unless specifically shown otherwise), in excess of 1 1/2 inches are permitted:
1. Manufactured Casework:
 - a. Genothern Cabinet Manufacturing Inc., Tumwater, WA (360) 352-3636
 - b. Westmark Commercial Casework, Tacoma, WA (253) 531-3470
 - c. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Core Material: All core material listed herein shall be "Boise Evergreen™" by Boise Cascade, or "Skyblend" by Roseberg Forest Products, Roseberg, Oregon.

2.02 MATERIALS, GENERAL

- A. Low-Emitting Materials: Fabricate manufactured wood casework, including countertops, with adhesives and composite wood products containing no urea formaldehyde.
- B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- C. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.
- D. Softwood Plywood: DOC PS 1.
- E. MDO Softwood Plywood: DOC PS 1.
- F. MDF: ANSI A208.2, Grade 130.
1. Recycled Content: Not less than 75 percent recycled content.
- G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, on color and material schedule or as selected by Engineer from full range of colors, (including "premium")

products) patterns, available textures from Wilsonart or approved substitute meeting specification requirements. Also see Color Schedule on the drawings.

- H. Edgebanding for Plastic Laminate: As is standard for the basis-of-design product specified herein.
- I. Edgebanding for Wood-Veneered Construction: Minimum 1/8-inch- (3-mm-) thick, solid wood of same species as face veneer, unless detailed otherwise.
 - 1. Select wood edgebanding for grain and color compatible with face veneers.
- J. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, with No. 4 satin finish.
- K. Plate Steel: Provide plate steel as detailed, associated with custom casework. Provide in accordance with the requirements of Division 5 Section "Metal Fabrications". Fully weld all joints, and grind all welds smooth. Powder coat steel in accordance with the requirements of Division 9 Section "Painting". Provide all necessary attachment hardware as detailed and as required by the design.
- L. Solid-Surfacing Material:
 - 1. Basis of Design: Corian Solid Surface. See Color Schedule on Drawings.
 - 2. Manufacturers: Subject to compliance with requirements, provide Basis of Design products, or comparable products by one of the following:
 - a. DuPont, USA.
 - 3. Thickness: $\frac{3}{4}$ "
- M. CORK FACING
 - 1. Manufacturers: Forbo, or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
 - 2. Product: "Forbo Cork," $\frac{1}{4}$ " thick
 - 3. Colors: See color schedule on Drawings
 - 4. Location: Cork (CK) at walls as noted on finish schedule and interior elevations
 - 5. Backing: MDO or as recommended by manufacturer

2.03 CABINET MATERIALS

- A. Exposed Cabinet Materials:
 - 1. Plastic Laminate: Grade HGS.
 - 2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.
- B. Semi-exposed Cabinet Materials:
 - 1. Solid Wood: Sound lumber, selected to eliminate appearance defects, of same species as exposed wood.
 - 2. Plywood: Hardwood plywood of same species as exposed wood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.
 - 3. Plastic Laminate: Grade VGS.
 - a. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
 - b. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.

4. Unless otherwise indicated, provide specified edgebanding on all semi-exposed edges.

C. Concealed Cabinet Materials:

1. Solid Wood: Any species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood, with backs of same species as faces.
3. Plastic Laminate: Grade BKL.

2.04 DESIGN, COLOR, AND FINISH

- A. General Casework: Full overlay, "European style", with PVC edge banding as specified herein, as selected by Engineer from the manufacturer's full range of available colors. Basis-of-Design shall be Westmark "200" series or equivalent from an approved manufacturer, modified and customized in accordance with these Drawings and Specifications.
- B. Low Pressure Thermofused Melamine or Polyester Laminate (if specified) Colors, Patterns, and Finishes: As selected by Engineer from manufacturer's full range of available colors.
- C. PVC Edgebanding Color: As selected from casework manufacturer's full range.
- D. Solid-Surfacing Material Colors and Patterns: See the Color Schedule on the drawings.

2.05 CABINET FABRICATION, GENERAL

- A. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.
- C. Install glass to comply with applicable requirements of Division 8 Section "Glazing" and of FGMA "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.06 CABINET FABRICATION

- A. Wood-Faced Cabinet Construction: As required by referenced quality standards, but not less than the following:
 1. Bottoms of Cabinets and Tops of Wall Cabinets: 3/4-inch (19-mm) hardwood veneer-core plywood.
 2. Ends of Cabinets: 3/4-inch (19-mm) hardwood veneer-core plywood.
 3. Shelves: 3/4-inch (19-mm) hardwood veneer-core plywood.
 4. Base Cabinet Top Frames: 3/4-by-2-inch (19-by-51-mm) solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
 5. Base Cabinet Stretchers: 3/4-by-4-1/2-inch (19-by-114-mm) hardwood veneer-core plywood, particleboard, or MDF strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed
 6. Base Cabinet Subtops: 3/4-inch (19-mm) panel product glued and pinned or screwed.

7. Backs of Cabinets: 3/4-inch (19-mm) hardwood veneer-core plywood, dadoed into sides, bottoms, and tops where not exposed. Removable backs shall be provided where indicated on drawings, and where required to access concealed plumbing or wiring if required by code or other specification sections.
 8. Drawer Fronts: 3/4-inch (19-mm) hardwood veneer-core plywood or solid wood. Inside color to match cabinet interiors. Door fronts shall be attached to the sub-fronts with minimum of four #8 x 1-inch panhead screws. Edges shall be banded with material noted in paragraph 2.2 noted above.
 9. Drawer Sides and Backs: 1/2-inch (12.7-mm) solid-wood or hardwood veneer-core plywood, with glued dovetail or multiple-dowel joints. Drawer parts shall be joined together with 6 mm x 25 mm hardwood dowels 32 mm on centers.
 10. Drawer Bottoms: 1/4-inch (6.4-mm) hardwood veneer-core plywood glued and dadoed into front, back, and sides of drawers. Bottoms shall be tongues into sides, back and sub-front, glued and clamped to produce a rigid square drawer. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
 11. Doors 48 Inches (1220 mm) or Less in Height: 3/4 inch (19 mm) thick, with solid hardwood stiles and rails, MDF cores, and hardwood face veneers and crossbands.
 12. Doors More Than 48 Inches (1220 mm) in Height: 1-1/8 inches (29 mm) thick, with particleboard cores and wood face veneers and crossbands.
- B. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, unless indicated otherwise on Drawings or Specifications plastic-laminate faced.
 2. Shelves: Plywood core, as follows.
 - a. Band all edges with 0.018-inch thick PVC edgebanding to match cabinet face.
 - b. Adjustable shelves shall be supported on 4 shelf clips in cabinets up to 25-inches deep and 6 shelf clips in cabinets greater than 25-inches deep.
 - c. Fixed and adjustable shelves shall be type and thickness as specified hereinabove, overlaid with high pressure laminate on both sides. Edges shall be banded with specified PVC edgebanding.
 - d. Shelf Thickness:
 - 1) 30 inches wide or less: 3/4 inch.
 - 2) 31 to 40 inches wide: 1 inch.
 - 3) 41 to 48 inches wide: 1-1/8 inch.
 3. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced.
 4. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced.
 5. Drawer Sides and Backs: 1/2-inch (12.7-mm) thermoset decorative panels, with glued dovetail or multiple-dowel joints.
 6. Drawer Bottoms: Same as sides and backs.
 7. Doors: 3/4-inch (19-mm) MDF plastic-laminate faced.

- C. Leg Shoes: Vinyl or rubber, black, open-bottom type.
- D. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.07 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware, as required for proper casework construction and operation. Include fastenings and accessories as required.
 - 1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Concealed Hinges: Stainless-steel, concealed, medium duty hinges complying with BHMA A156.9, Grade 1. Complete concealment with door closed, self-closing with three-way independent screw action adjustment, door opening of 120 degrees, minimum. Provide 2 hinges for doors less than 48 inches (1220 mm) high and 3 hinges for doors more than 48 inches (1220 mm) high.
- C. Standard Pulls: Solid stainless-steel pulls, Berenson Metro, Uptown Appeal in brushed nickel, 5" long fastened from back with two screws. For sliding doors, provide recessed stainless-steel flush pulls. Provide 2 pulls for drawers more than 24 inches (600 mm) wide. Provide for all locations, except for locations specifically noted for special pulls.
- D. Door Catches: Zinc-plated, dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than 48 inches (1220 mm) high.
- E. Drawer Slides: BHMA A156.9, Type B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides. Full extension slides. Provide positive in and out stops, stay close detent, and steel ball bearings.
 - 2. Box Drawer Slides: Grade 1HD-100, for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide. Full extension slides. Provide positive in and out stops, stay close detent, and steel ball bearings.
 - 3. File Drawer Slides: Grade 1HD-200, for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide. Full extension slides. Provide positive in and out stops, stay close detent, and steel ball bearings.
 - 4. Pencil Drawer Slides: Grade 1, for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide. Full extension slides. Provide positive in and out stops, stay close detent, and steel ball bearings.
 - 5. Keyboard Slides: Grade 1HD-100, for computer keyboard shelves.
 - 6. Trash Bin Slides: Grade 1HD-200, for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide. Full extension slides. Provide positive in and out stops, stay close detent, and steel ball bearings.
- F. Label Holders: Stainless steel, sized to receive standard label cards approximately 1 by 2 inches (25 by 51 mm), attached with screws or brads.
 - 1. Provide label holders where indicated.
- G. Drawer and Hinged Door Locks: Mortise type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Lock cylinders to be furnished by Division 08 Section "Door Hardware" and installed under this section. Locks to be dead bolt type, constructed with solid brass cylinder and five pin tumblers. Exposed finish to be US26D satin chrome. Keying shall be alike per room, different between rooms and master keyed. Provide 10 master keys and 5 keys per room. Olympus model 720 Series lock.
 2. Provide a minimum of two keys per lock and six master keys.
 3. Provide locks where indicated.
- H. Adjustable Shelf Supports: Mortise-type, zinc-plated steel standards and shelf rests complying with BHMA A156.9, Type B04071 and B04091.
- I. Support Brackets:
1. Unless detailed otherwise, countertop support brackets shall be constructed of 16 gauge 1 1/2" tube steel, with welded construction. Brackets to be powder coated to match cabinet interiors.
 - a. 18" x 21" legs for up to 26" deep countertop.
 - b. 21" x 27" legs for up to 32" deep countertop.
- J. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, color to match counter top color (unless indicated otherwise on Color Schedule on drawings), molded-plastic grommets and matching plastic caps with slot for wire passage.

2.08 OTHER MATERIALS

- A. Support Brackets:
1. Unless detail otherwise, countertop support brackets shall be constructed of 15 gauge 1 1/2" tube steel, with welded construction. Brackets to be powder coated to match cabinet interiors. 18" x 21" legs for up to 26" deep countertops. 21" x 27" legs for up to 32" deep countertops.
 2. Single shelf support brackets shall be constructed of 1 1/4" flat bar with 1/4" wire rod gusset. Brackets shall all be welded construction designed to support up to a 15" deep wall shelf. Brackets to be powder coated to match cabinet interiors.

2.09 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.
- B. Solid-Surfacing-Material Tops: 3/4" thick, as indicated on the drawings, solid-surfacing material with front edge built up with same material.
1. Front: Straight, eased edge at all exposed faces, unless detailed otherwise on the drawings.
 2. Backsplashes: 3/4-inch- (19-mm-) thick, solid-surfacing material; eased edge unless detailed otherwise on the drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, substrates, location of framing and reinforcements, temperature, humidity, and other conditions affecting performance of manufactured wood casework.

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

3.02 CASEWORK INSTALLATION

A. Attachment, General:

1. All casework items shall be securely anchored to building walls and floors, except for those items identified as "mobile" or "moveable" on drawings, which are to be adjusted to prevent any rocking when sitting on finish floor.
2. Primary anchorage of base and wall cabinets shall be through the 1/2" thick cabinet back into wall framing or blocking furnished under other sections. Additional anchorage will be made into cabinet bases and adjacent side walls where they occur. Appropriate sized anchor screws shall be used to best attach to the existing wall condition which will allow each cabinet to be loaded to a capacity of 50 lb. per sq. ft. of shelf area.
3. Installations shall be in strict conformance with seismic codes.
4. At free-spanning countertops or work surfaces, steel support bracket shall be provided at a maximum spacing of 32 inches, or as shown on drawings. Support brackets are to be designed to allow for knee space clearance and attach to wall framing for support. Powder coat to match adjacent wall color.

B. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 16 inches (400 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm) o.c.
2. Use toggle bolts at hollow masonry.
3. Use expansion anchors at solid masonry.
4. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.

E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

F. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

- G. Plastic Laminate Wainscots: Adhere to wall at locations shown with backing and adhesive as recommended by the manufacturer. Install with aluminum edge and joint trim.

3.03 INSTALLATION OF TOPS AND WINDOW SILLS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure backsplashes and end splashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and walls with adhesive.
- E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.04 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces with low VOC liquid cleaner as recommended by manufacturer, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Engineer.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 03 30 00.01 – “Cast-in-Place Concrete” for setting sleeves, inserts, and anchoring devices in concrete.
 2. Section 05 12 00.01 – “Structural Steel Framing” for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Hoist beams.
 - c. Structural-steel shapes for subsills that are part of steel frame.
 3. Section 05 50 00.01 – “Metal Fabrications” for the following:
 - a. Structural-steel shapes for subsills.
 - b. Ladders
 4. Section 09 29 00.01 – “Gypsum Board” for shaft.
 5. Division 26 Sections for electrical service for elevators to and including disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
 6. Division 27 Sections for telephone service for elevators.
 7. Division 28 Sections for smoke detectors to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.02 SUMMARY

- A. Section includes hydraulic passenger elevator.

1.03 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.04 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 2. Include large-scale layout of car-control station and standby power operation control panel.
 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, 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. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Port, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.08 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1 (current edition), and the applicable sections of the International Building Code as adopted by the State of Washington and agency having jurisdiction.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Affected peak velocity acceleration (A_v) for Project's location is greater than or equal to 0.20 (seismic risk Zones 3 and 4).
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (S_d s) for Project is 0.821 and should be calculated per ASCE. See structural notes on drawings for additional information.
6. Project's Seismic Design Category: D.
7. Elevator Component Importance Factor: 1.5.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.10 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.
- D. The Contractor shall be responsible to coordinate both the local agency having jurisdiction and the State of Washington, Department of Labor and Industries (elevator group) to assure that all aspects of the elevator shaft and the elevator machine room meet both agencies requirements, including but not limited to clearances, fire protection systems, fire ratings, and other code elements.

1.11 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 2. Warranty Period: 1 year.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EcoSpace™ traction elevators by KONE, Inc. or comparable product by one of the following:
 - 1. Schindler Elevator Corp.
 - 2. Thyssen
 - 3. Or approved substitute during the bid process per the Instructions to Bidders and Specification Section 00 26 00.
- B. Source Limitations: Obtain elevators from single manufacturer.
 - 1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.02 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Type: Type as is standard for the basis-of-design product.
 - 2. Rated Load: 2,000lb
 - 3. Rated Speed: 150fpm
 - 4. Operation System: Single automatic.
 - 5. Control Space Location: Remote Closet, see drawings for location.
 - 6. Power Requirements: 480 volt, 3-phase, 60 hertz. Coordinate with electrical.
 - 7. Auxiliary Operations:
 - a. Standby power operation.
 - b. Automatic dispatching of loaded car.
 - c. Nuisance call cancel.
 - d. Batten powered lowering unit shall be provided to automatically return the elevator to its lowest landing at normal speed in a power failure and allow passengers to exit safely.
 - 8. Car Enclosures:
 - a. Inside Width: 6'- 8' from side wall to side wall.
 - b. Inside Depth: 4' – 9' from back wall to front wall (return panels).
 - c. Inside Height: 8' to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
 - e. Car Fixtures: Satin stainless steel, No. 4 finish.

- f. Side and Rear Wall Panels: Plastic laminate. Color: as selected by Engineer from manufacturers standard colors.
 - g. Reveals: Satin stainless steel, No. 4 finish.
 - h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - i. Door Sills: Aluminum, mill finish.
 - j. Ceiling: Luminous ceiling.
 - k. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides and rear of car.
 - l. Control Space Location: Remote, see Drawings
 - m. Floor material: Manufactures standard rubber flooring Color: as selected by Engineer from manufactures standard colors.
9. Hoistway Entrances:
- a. Width: 36 inches (914 mm).
 - b. Height: 84 inches (2134 mm).
 - c. Type: Single-speed side sliding.
 - d. Frames: Satin stainless steel, No. 4 finish.
 - e. Doors: Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum, mill finish.
10. Hall Fixtures: Satin stainless steel, No. 4 finish.
11. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads in all cars complete set(s) of full-height protective pads.

2.03 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

- A. Controller: Provide microcomputer based control system to perform all of the functions.
- 1. All High protected (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open
 - 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
 - 3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
 - 4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.
- B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.

- C. Controller Location: Within 100'-0" (30.48m) Controllers shall be located in a remote cabinet within 140'-0" (42.6 m) wire feet of the elevator machine.

2.04 EQUIPMENT: HOISTWAY COMPONENTS

- A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.
- B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.
- C. Buffers, Car and Counterweight: Polyurethane buffer.
- D. Hoistway Operating Devices:
 - 1. Emergency stop switch in the pit.
 - 2. Terminal stopping switches.
 - 3. Emergency stop switch on the machine.
- E. Positioning System: System consisting of magnets and proximity switches.
- F. Guide Rails and Attachments: Steel rails with brackets and fasteners.
- G. Emergency Car Signals
 - 1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.
 - 2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
 - 3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit
 - 4. Ventilation: Fan

2.05 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: Provide vandal resistant car operating panel with all push buttons, key switches, and message indicators for elevator operation. Fixture finish to be: Textured Stainless Steel.
 - 1. Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have blue illumination (halo). All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be blue DOT-matrix. All texts, when illuminated, shall be blue. The car operating panel shall have a brushed stainless steel finish. Additional features of car operating panel shall include:
 - a. Car Position Indicator within operating panel blue.
 - b. Elevator Data Plate marked with elevator capacity and car number on car top.
 - c. Help buttons with raised markings.
 - d. In car stop switch per local code.
 - e. Firefighter's hat.

- f. Firefighter's Phase II Key-switch.
 - g. Call Cancel Button.
 - h. Pre-programmed integrated ADA phone (complete description of krms features included as standard)
 - i. Help Button/Communicator. Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
 - j. Firefighter's Phase II emergency in-car operating instructions.
 - k. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
- B. Hall Fixtures: Wall mounted (vandal resistant) hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a brushed stainless steel finish.
- 1. Hall fixtures shall feature round, mechanical, buttons in applied mount face frame. Hall fixtures shall correspond to options available from that landing. Buttons shall be in a vertically mounted fixture. Hall fixtures shall not be jamb-mounted. Hall lanterns shall feature blue illumination.
- C. Car Lantern and Chime: A (vandal resistant) directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down.
- D. Hall Lanterns and Chime: A vandal resistant directional lantern visible from the corridor shall be provided at each hall entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down. The car riding lantern face plate shall have a Scottish Quad Textured Steel finish.
- E. Combination Hall Position Indicator and Hall Lantern located at First Floor. Hall lanterns and hall indicators shall feature blue illumination; all numbers will be blue display.

2.06 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

- A. Elevator Operation
- 1. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
 - 2. Independent Service.
 - 3. Intercom Provisions
 - 4. Emergency Battery Power Supply
 - a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. The elevator will rise or lower to the first available landing, open the doors, and shut down. The elevator will return to service upon the return of normal main line power. An auxiliary

contact on the main line disconnect and shunt trip breaker (if used) will be provided by others.

B. Elevator Control System for Inspections and Emergency

1. Provide devices within controller to run the elevator in inspection operation.
2. Provide within controller to run the elevator in inspection operation.
3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
4. Provide the means from the controller to mechanically lift and control the elevator brake to safety bring car to nearest available landing when power is interrupted.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
7. Provide the means for the control to reset elevator earthquake operation.

2.07 EQUIPMENT: DOOR OPERATOR AND CONTROL

- A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.
- B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.
- C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.
- D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.
- E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions

and examine supporting structure and other conditions under which elevator work is to be installed.

- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: -0 inches +2 inches. Do not begin work of this section until dimensions are within tolerances.
- E. Prior to start of Work, verify projections greater than 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less than 75 degrees from horizontal.
- F. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
- G. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.
- H. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.
- I. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.02 PREPARATION

- A. Install Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.03 CONSTRUCTION

- A. Interface with Other Work:
 - 1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
 - 2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
 - a. Ensure adequate support for entrance attachment points at all landings.
 - b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
 - c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
 - d. Coordinate interface of elevators and fire alarm system.
 - e. Coordinate interface of dedicated telephone line.
 - f. Coordinate the installation of the non-fused three phase permanent power disconnect in hoist way at top landing.

3.04 TESTING AND INSPECTIONS

- A. Perform recommended and required testing in accordance with authority having jurisdiction.
- B. Obtain required permits and provide originals to the Engineer.

3.05 INSTALLATION

- A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.
- B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.
- C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.
- D. Lubricate operating system components in accordance with manufacturer recommendations.
- E. Perform final adjustments, and necessary service prior to substantial completion.
- F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- G. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- H. Install piping above the color, where possible. Install underground piping in casing.
- I. Lubricate operating parts of systems as recommended by manufacturers.
- J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- K. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
- L. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- M. Located hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.06 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Engineer, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.07 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.

3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Port's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of each elevator with Port's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.09 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include twelve months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 1. Perform maintenance during normal working hours.
 2. Perform emergency callback service during normal working hours with response time of two hours or less.
 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 GENERAL

- A. Includes, but not limited to, furnishing labor, materials, and equipment for completion of work unless indicated or noted otherwise. See Division 01 for sequence of work.
- B. All work included in Division 22 and 23 shall be the responsibility of a single Subcontractor.
- C. This Contractor shall obtain and pay for all permits required by State and local authorities governing the installation of the mechanical work. It is the Contractor's responsibility to contact all utility organizations serving the building, prior to bid, and to include all charges for inspections, installation of materials, equipment and connection of all required utilities.
- D. Furnish exact location of electrical connections and complete information on motor controls to Division 26, prior to bid.
- E. Putting heating, ventilating, cooling, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
- F. Making changes in mechanical drive systems (pulleys, belts, VFD's, motor speed, etc) and dampers or adding dampers as required for correct balance as recommended by Section 23 05 93.01 and at no additional cost to the Port. All equipment shall be provided with a single point electrical connection, unless otherwise indicated.
- G. The drawings and specifications are complementary and what is called for in either is binding as if called for in both.
- H. The ductwork and accessibility to HVAC equipment shall take precedence over all other equipment in the ceiling interstitial spaces or other mechanical areas including, but not limited to, sprinkler piping, heating piping, domestic water piping and electrical conduit (except fire pump rooms where as fire sprinkler equipment takes precedence).

1.03 SUBMITTALS REQUIREMENTS OF THIS SECTION

- A. Access Doors
- B. Commissioning Plan
- C. Systems Testing and Balancing
- D. Controls Functional Performance Testing
- E. Preliminary Commissioning Report
- F. Post Construction Documentation
- G. Final Commissioning Report

1.04 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Perform work in accordance with applicable Codes.
 - 2. In case of differences between building codes, state laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern.
- B. Product Approvals: See paragraphs elsewhere in this specification.

C. Warranties:

1. In addition to guarantee specified in General Conditions, guarantee heating, cooling, and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
2. In order to be protected, secure proper guarantees from suppliers and Subcontractors.
3. Provide certificates of warranty for each piece of equipment. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.

D. Identification: Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Project is turned over to Port.

1.05 CODES AND STANDARDS

A. Codes and agencies having jurisdictional authority over mechanical installation.

1. Washington State Energy Code -- Latest Approved Edition
2. International Building Code -- Latest Approved Edition
3. International Fire Code -- Latest Approved Edition
4. International Mechanical Code -- Latest Approved Edition
5. Uniform Plumbing Code -- Latest Approved Edition
6. Local Sewer and Water District Requirements
7. State and County Department of Health
8. Local Fire Marshal
9. State Boiler Inspector
10. Puget Sound Air Pollution Control
11. State of Washington Boiler and Unfired Pressure Vessel Inspection Law
12. Occupational Safety and Health Administration (OSHA)
13. Washington Industrial Safety and Health Act (WISHA)
14. National Fire Protection Association (NFPA)

B. ASME code stamp required on all pressure vessels and relief valves. Certificate required from the State Boiler Inspector showing approval of the equipment and its installation.

1.06 SYSTEMS DESCRIPTION

A. Site Inspection:

1. Examine premises and understand the conditions which may affect performance of work of this Division before submitting proposals for this work.
2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

1.07 DESIGN DRAWINGS

A. Mechanical drawings are not shop drawings and are intended to show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.

- B. Consider architectural, structural and electrical drawings part of this work in so far as these drawings furnish information relating to design and construction of building. Architectural drawings take precedence over mechanical drawings.
- C. Because of small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall include in the bid a sufficient quantity of offsets, fittings, and accessories for the size of the project, based upon the contractor's experience, necessary to facilitate mechanical utility installation. No additional costs shall be charged for additional offsets, fittings, and accessories required to install the mechanical utilities shown on the design drawings. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

1.08 PRE-CONSTRUCTION COORDINATION MEETING

- A. The Contractor is responsible to participate in coordination meetings with the other subcontractors needing to coordinate special requirements (such as electrical contractor, HVAC contractor, plumbing contractor, etc.)
- B. Coordination meetings shall consider elevations, required clearances, and routings of all trades to assure that all trades can be installed without conflict.
- C. The outcome of this coordination shall allow each system (Mechanical, Fire Protection, Plumbing, Electrical, etc) to be installed without further conflicts for space or locations.
- D. Failure to coordinate with other trades and/or existing conditions that result in the removal and re-installation of systems shall not be charged as additional costs.

1.09 COORDINATION DRAWINGS

- A. Develop coordination drawings, and other pre-installation coordination methods as necessary to coordinate layouts prior to installation. Coordination drawings shall consist of overlay drawings, or other similar methods to graphically indicate plumbing, fire protection, HVAC, electrical, and other similar elements in a single location in order to identify conflicts. All elements shall be drawn to scale. Coordination drawings are not required to be submitted for approval, except where indicated otherwise in the specification. However, a minimum of one hard copy of coordination drawings shall be present on site at all times and made available to the Engineer upon request. If coordination drawings are not on file, or if systems are not installed per coordination drawings, costs and delays of required reengineering, replacement and other work required to correct conflicts shall be solely the Contractor's.
 - 1. Contractor shall have the underground coordination drawings available upon request by the Engineer within 60 days after Notice to Proceed.
 - 2. Contractor shall have the aboveground coordination drawings available upon request by the Engineer within 90 days after Notice to Proceed.
- B. Coordination drawings shall consist of one of the following:
 - 1. Drawing sheets developed sequentially by each trade with all components drawn to scale and color coded to represent each trade.
- C. Where coordination drawings, or other preinstallation coordination methods show that available space is inadequate or that modifications will affect architectural elements, request information from the Engineer before proceeding with work. No additional payment will be made for installation conflicts which could have been identified by coordination drawings or other pre-installation coordination methods.

- D. Make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. Each subcontractor shall:
 - 1. Indicate the exact name, location and dimension of each element to be provided by that subcontractor.
 - 2. Arrange components as necessary to avoid conflict with new and existing conditions and the work of other subcontractors.
 - 3. Note requirements for sleeves, block-outs, cutting, patching, access doors, blocking, supports, inserts and other similar items.
 - 4. Approve the coordination drawings when all conflicts are resolved and an acceptable layout is obtained.
- F. The Contractor shall coordinate the layouts indicated on the coordination drawings and resolve any conflicts prior to commencement of subject portions of the work.

1.10 ELECTRICAL

- A. All electrical work, conduit, boxes and devices in connection with control wiring as required to install the control equipment as specified herein or shown on the drawings shall be furnished and installed complete by the Contractor.
- B. All electrical work performed under this Section of the Specifications shall conform to all applicable portions of the Division 26 specifications and shall conform to all governing codes.
- C. All equipment shall be factory wired to a junction box for connection to electrical service.
- D. Where a piece of equipment specified includes an electric motor, the motor shall be furnished and mounted by the Contractor. Motor starter, disconnect switches and wiring from the electrical panel to the motor control devices and to the motor shall be provided by the Contractor unless stated otherwise in the mechanical specification and/or on the mechanical drawings.
- E. All motor controllers and equipment panels (including but not limited to packaged equipment, custom control panels, custom air handler panels) shall comply with NEC (including, but not limited to, marking on controllers and labeling requirements).

1.11 TEMPORARY HEATING

- A. Temporary heating for facility during construction phase shall not be supplied by the permanent system installed under these specifications, unless all of the following are satisfied:
 - 1. Product warranties shall be extended to account for construction use. Contractor shall furnish certified document stating such extended warranties.
 - 2. Contractor shall obtain letter of approval from the Engineer stating that they understand equipment expected life may be shortened due to severe usage.
 - 3. Contractor shall be responsible for pressure cleaning all coils and vacuum cleaning all ductwork prior to occupancy.

1.12 PRODUCT HANDLING AND PROTECTION

- A. Contractor is responsible for protection of all material, equipment and apparatus provided under this Section from damage, water, corrosion, freezing and dust, both in storage and when installed, until final project acceptance.
- B. Provide temporary heated and sheltered storage facilities for material and equipment.

- C. Completely cover motors and other moving machinery to protect from dirt and water during construction.
- D. Handle and protect equipment and/or material in manner precluding unnecessary fire hazard.
- E. Equipment requiring rotation and/or lubrication during storage shall have records maintained and witnessed on a monthly basis and forwarded to the Engineer prior to acceptance. Provide recorded maintenance for the O&M Manual.
- F. Material or equipment damaged because of improper storage or protection will be rejected.
- G. Equipment finish that is damaged by handling, storage, etc. shall be corrected by the Contractor at no additional cost to the Port.

1.13 DEFINITIONS

- A. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- B. Unfinished Spaces: Spaces used for storage or work areas, such as fan rooms, mechanical and boiler rooms, etc., where appearance is not a factor.
- C. Concealed Spaces: Spaces out of sight. For example, above ceilings; below floors; between double walls; furred-in areas; pipe and duct shafts; and similar spaces.
- D. Exposed: Open to view. For example, pipe running through a room and not covered by other construction.
- E. Outside: Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.
- F. Conditioned Space: An area, room or space normally occupied and being heated or cooled for human habitation by any equipment as defined by the extent of the building envelope insulation.
- G. Replace: Existing mechanical equipment and components shall be demolished and discarded from the project site or as directed otherwise. New mechanical equipment and components shall be installed in the area where the existing mechanical equipment and components were demolished or as indicated on the contract documents.
- H. Removed: Existing mechanical equipment and components identified on the contract documents shall be taken apart, taken down, and discarded from the project site unless directed otherwise on plan. Removed items shall not be brought back to the project site for use or reinstallation.
- I. Reinstall: Existing mechanical equipment and components identified on the contract documents that need to be taken down and installed in the same or new location.

1.14 ABBREVIATIONS

ADA	Americans with Disabilities Act
A/E	Architect/Engineer
AFF	Above Finish Floor
AGA	American Gas Association
AMCA	Air Moving & Conditioning Association
ANSI	American National Standards Institute
APWA	American Public Works Association
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing & Materials
AWWA	American Water Works Association
BFF	Below Finish Floor
BHP	Brake Horsepower
BTU	British Thermal Unit
CFM	Cubic Feet per Minute
CISPI	Cast Iron Soil Pipe Institute
fpn	feet per minute
FS	or Federal Specifications
F.D.C.	Fire Department Connection
F.C.O.	Flush Cleanout
F.D.	Floor Drain
FWH	Freeze Proof Wall Hydrant
GPM	Gallons per Minute
HP	Horsepower
IAPM	International Association of Plumbing and Mechanical Officials
IAQ	Indoor Air Quality
IEEE	Institute of Electrical and Electronics Engineers
KW	Kilowatt
LPG	Liquefied Petroleum Gas
MBH	One Thousand British Thermal Units per Hour
MS	or
Mil.Spec.	Military Specifications
MSS	Manufacturers Standardization Society
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NP	Non-Potable Water
NPSH	Net Positive Suction Head
OS&Y	Outside Screw and Yoke
P.I.V.	Post Indicator Valve
PDI	Plumbing and Drainage Institute
per	in accordance with
POC	Point of Connection

PSI	Pounds per Square Inch Gauge Pressure
PVC	Polyvinyl Chloride
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SP	Static Pressure
SWP	Steam Working Pressure
UL	Underwriter's Laboratories
VFD	Variable Frequency Drive
VTR	Vent Thru Roof
w.g.	Water Gauge (inches of water)
W.P.	Working Pressure
WPL	Weatherproof Louver
WQA	Water Quality Association

Additional abbreviations are as listed on the drawings or elsewhere in these specifications.

1.15 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

- A. Provide master index at beginning of Manual showing items included. Use plastic permanent tab indexes for Sections of Manual.
- B. First Section shall consist of name, address, and phone number of Architect, General Contractor, and Mechanical, Plumbing, Sheet Metal, Refrigeration, Temperature control, and Electrical Subcontractors. Also include complete list of equipment installed with name, address, and phone number of each vendor.
- C. Provide Section for each type of item of equipment.
- D. Submit copies as specified by Division 01 and at a minimum provide three (3) copies of Operation & Maintenance Manual to Engineer for his approval.
- E. Include descriptive literature (Manufacturer's catalog data) of each manufactured item. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
- F. Include all warranties/guarantees including extended warranties.
- G. Include all start-up logs.
- H. Operating Instructions shall include:
 - 1. General description of each mechanical system.
 - 2. Step-by-step procedure to follow in putting each piece of mechanical equipment into operation.
 - 3. Provide schematic control diagrams for all systems. Each diagram shall show locations of start-stop switches, insertion thermostats, room thermostats, thermometers, firestats, pressure gauges, automatic valves, refrigeration accessories. Mark correct operating settings for each control instrument on these diagrams.
 - 4. Provide diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays.

5. Provide drawing of each temperature control panel identifying components on panels and their function.
- I. Maintenance Instructions shall include:
 1. Manufacturer's maintenance instructions for each piece of mechanical equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists operation instructions of equipment, and maintenance and lubrication instructions.
 2. Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
 3. List of mechanical equipment used indicating name, model, serial number, and name plate data of each item together with number and name associated with each system item.

1.16 COMMISSIONING

- A. General Requirements: The building systems shall be tested to ensure that control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with the approved plans and specifications.
- B. Commissioning Plan: A commissioning plan shall be prepared and shall include at a minimum the following:
 1. A detailed explanation of the design intent.
 2. Equipment and systems to be tested.
 3. Functions to be tested (for example, economizer control, discharge air temperature control, etc.)
 4. Conditions under which the test shall be performed.
 5. Measureable criteria for acceptable performance.
- C. System Testing and Balancing: Provide testing and balancing as specified in Sections 23 05 93.01.
- D. Controls Functional Performance Testing: Functional testing shall demonstrate the correct installation and operation of each component, system, and system to system intertie relationship in accordance with the plans and specifications. This demonstration is to prove operation, function, and maintenance serviceability for each of the commissioned systems. Testing shall include all modes of operation, including:
 1. All modes as described in the sequence of operation.
 2. Performance of alarms.
 3. Mode of operation upon a loss of power and restored power.
 4. The HVAC control system shall be tested to ensure that control devices, components, equipment, and systems are calibrated, adjusted, and operate in accordance with the plans and specifications.
- E. Preliminary Commissioning Report: The preliminary commissioning report shall be provided to the Engineer. The Contractor is responsible to submit to the code official a signed letter by the Engineer acknowledging the acceptance of the preliminary commissioning report. The preliminary commissioning report shall include test procedures and results, and shall identify the following:

1. Deficiencies found during testing which have not been corrected at the time of report preparation and the anticipated date of correction.
 2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions. Include the climatic conditions required for testing and the anticipated date of each deferred test.
 3. Record of progress and completion of operator training.
- F. Post Construction Documentation: Provide Operation and Maintenance (O&M) data, as-built record drawings, and Port training as specified in this section.
- G. Final Commissioning Report: Provide a complete report of test procedures and results and submitted to the Engineer. The report shall identify the following:
1. Procedures and results of all functional performance tests.
 2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.

1.17 AS-BUILT DRAWINGS

- A. The Contractor shall maintain, in addition to coordination drawings, an as-built set of prints that clearly identify all deviations from the original design. The As-Built drawings shall be drafted per one of the following methods:
1. Draft all revisions on a separate dark layer, on the coordination drawing set. The Contractor shall maintain a copy of the original coordination drawing set.
 2. Draft all revisions on the design drawings with a red color pencil.
- B. This red lined set shall identify all drawing revisions including addenda items, change orders, and Contractor revisions.
- C. Drawings shall show locations of all underground pipe and duct installed by this Contractor. Underground pipes and ducts shall be shown with cross section elevations. All pipe, raceway, manholes or lines of other trades shall be included.
- D. The Contractor shall update all references to specific products to indicate products actually installed on project. This shall include, but not be limited to, air handlers, heat pumps etc.
1. Upon completion of the Division 22 and 23 Work, the Contractor shall deliver the red lined drawings and one set of neatly drafted as-built drawings to the Engineer.

PART 2 - PRODUCTS

2.01 ACCESS DOORS

- A. This Contractor shall be responsible for furnishing and installing flush mounted access doors in walls, ceiling and floors and chases where the following equipment is concealed and is not accessible through same.
1. Valves (shut off, balancing, control, trap primers, etc).
 2. Dampers (control, balancing, fire, smoke, etc.).
- B. Doors shall be UL listed 20 ga. cold rolled steel with concealed hinge, screwdriver operated lock and prime coated. Furnish suitable for area mounted. Provide stainless steel access doors for non-painted surfaces (i.e. tile, MDF)
- C. Approved Manufacturers:
1. Milcor

2. Acudor
3. Greenheck
4. Nystrom

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. This Contractor shall provide completed systems with a neat and finished appearance. If, in the judgment of the Engineer, any portion of the work has not been performed in a workmanlike manner or is left in a rough, unfinished state, this Contractor will be required to remove, reinstall or replace same and patch and paint surrounding surfaces in a manner acceptable to the Engineer, without increase in cost to the Port.

3.02 FINAL INSPECTION

- A. Final Inspection:
 1. Prior to acceptance of the mechanical work, the Contractor shall put all mechanical systems into operation for a period of not less than 5 working days so that they may be inspected by the Engineer.
 2. The time of the final inspection shall be mutually agreed to by the Engineer and Contractor.
 3. The Contractor shall furnish adequate staff to operate the mechanical systems during inspection.

3.03 OPERATION AND MAINTENANCE TRAINING

- A. Upon completion of the work, and after all tests and final inspection of the work by the Authority(s) having jurisdiction, the Contractor shall demonstrate and instruct the Port's designated operation and maintenance personnel in the operation and maintenance of the various mechanical systems. The Contractor shall arrange scheduled instruction periods with the Engineer. The Contractor's representatives shall be Superintendents or Foremen knowledgeable in each system and Supplier's Representative when so specified.
- B. Scheduled instruction periods shall be:

HVAC System Controls	8 Hours
HVAC Equipment Maintenance	4 Hours
Plumbing Equipment	2 Hours
- C. The contractor shall, at a minimum, include an O&M Training sign-in sheet in the O&M Manual that indicates the start and end times of the training and the type of training provided. Engineer shall sign off on the O&M training sign-in sheet to be considered complete and satisfactory to Engineer.
- D. Costs for time involved by Contractor shall be included in the bid.

3.04 CLOSEOUT SUBMITTALS

- A. Requirements: Final approval of mechanical installation will be recommended upon completion of the following:
 1. Completion of all punchlist items
 2. O&M Training Sign-In sheet with Engineer's signature
 3. Permit Submittal

4. Valve Diagrams
5. Reproducible As-Built drawings delivered to Architect
6. Air Balance Report
7. Asbestos Free Statement
8. Guarantees
9. Equipment Manufacturer of all HVAC compressor units shall provide start-up logs.
10. EMCS Trend Logs.

3.05 PREPARATION

- A. New Buildings: Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

3.06 INSTALLATION

- A. Install mechanical equipment to permit easy access for normal maintenance, and so that parts requiring periodic replacement or maintenance, (e.g., coils, heat exchanger bundles, sheaves, filters, motors, bearings, etc.) can be removed. Relocate items, which interfere with access.
- B. Provide access doors in equipment, ducts, and walls/ceilings as required to allow for inspection and proper maintenance.
- C. Valves, damper operators, and other devices which are manually adjusted or operated shall be located so as to be easily accessible by a person standing on the floor. Any such items which are not in the open shall be made accessible through access openings in the building construction.
- D. Gauges, thermometers, instrumentation and other components which are installed to monitor equipment performance, operating conditions, etc., shall be oriented so as to be easily read by a person standing on the floor. Provide necessary brackets and hangers as needed.
- E. If circumstances at a particular location make the accessible installation of an item difficult or inconvenient, the situation shall be discussed with the Engineer before installing the item in a poor access location.
- F. Belts, pulleys, couplings, projecting set screws, keys and other rotating parts which may pose a danger to personnel, shall be fully enclosed or guarded in accordance with OSHA regulations.
- G. Dissimilar Metals: Provide separations between all dissimilar metals. Where not specified in another way, use 10 mil black plastic tape wrapped at point of contact or plastic centering inserts.
- H. Provide offsets around all electrical panels (and similar electrical equipment) to maintain space clear above and below panel to structure and clearance of 3.5 feet directly in front of panel, except where indicated otherwise or required by NEC to be more. Such offsets are typically not shown on the drawings, but are required per this paragraph.
- I. Piping Through Framing: Piping through framing shall be installed in the approximate center of the member. Where located such that nails or screws are likely to damage the pipe, a steel plate at least 1/16-inch thick shall be installed to provide protection. At metal framing, wrap piping to prevent contact of dissimilar metals. At metal and wood framing, provide plastic pipe insulators at piping penetrations through framing nearest each fixture and on at least 48-inch centers.

- J. Safety Protection: All ductwork, piping and related items installed by this Contractor that present a safety hazard (i.e., items installed at/near head height, items projecting into maintenance access paths, etc.) shall be covered (at hazardous area) with 3/4" thick elastomeric insulation and 2" wide reflective red/white striped self-sticking safety tape.
- K. Equipment Access: Access to equipment is of utmost importance. Contractor shall apply extra attention to the laying out of pipe and duct routings, and in coordinating all work. Poor access to equipment will not be accepted. Contractor shall note that in essentially all areas, piping routed in ceiling space needs to run in joist space, necessitating elbows/fittings/transitions at crosses with other trades, at structural beams, and at all connections to mains and branches. Hatched areas at HVAC units indicate equipment access areas. These (and all other) access areas shall be clear of obstructions. The Contractor is responsible to coordinate and ensure that all trades stay clear of access areas for any Division 22 and 23 furnished equipment.
- L. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents.
- M. Pipe Installation: Install piping in longest reasonable lengths. The use of short lengths of pipe with multiple couplings where a single length of pipe could have been used is not acceptable.

3.07 CONCRETE BASES

- A. Provide a 3-inch high "minimum" concrete base under hot water tanks located in mechanical/utilities spaces. Provide 6" thick structural concrete pad for equipment located outside the building or as detailed on drawings.

3.08 ADJUSTMENT AND CLEANING

- A. Properly lubricate equipment before Engineer's acceptance.
- B. Clean exposed piping, ductwork, equipment, and fixtures, remove debris from site. Repair damaged finishes and leave everything in working order.
- C. Remove stickers from fixtures and adjust flush valves.

3.09 PAINTING

- A. Paint all exposed pieces of equipment if not factory finished or painted under the Architectural Section of these specifications. Paint shall be one coat primer and two coats enamel color as directed by the Engineer.

3.10 REBATES

- A. Furnish vendor invoices on heat pumps to Engineer after installation for power company rebates.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 21 11 23.01 - "Private Fire Service Mains".
 - 2. Section 21 13 13.01 - "Wet Pipe Automatic Sprinkler Systems".

1.02 GENERAL

- A. Includes, but not limited to, furnishing labor, materials, and equipment for completion of work unless indicated or noted otherwise. See Division 1 for sequence of work.
- B. The Fire Protection Contractor shall review all Architectural drawings to determine if the installed work is to be "Phased". The Fire Protection Contractor shall make the necessary accommodations (caps, valves, minimize penetrations between phased areas, etc.) on the submittal drawings to conform to the Engineer's "Phasing Plan".
- C. The Fire Protection Contractor shall obtain and pay for all permits required by State and local authorities governing the installation of the fire protection work.
- D. The fire protection specifications are a mix of being performance based and prescriptive. It is the Fire Protection Contractor's responsibility to determine the exact pipe routing, elevations, and device locations that will meet N.F.P.A. #13, N.F.P.A. #24, local Authority Having Jurisdiction, and project specification requirements.
- E. The Fire Protection Contractor may request a pre-design meeting with the Engineer, Fire Protection Engineer, Fire Protection Contractor, General Contractor, and the Engineer to answer any specification and contract design related questions during the early design phase of the project. The Fire Protection Contractor shall provide a written request for this meeting to the Engineer.
- F. **All fire protection sprinkler system components and devices shall be domestically manufactured. Imported components will not be allowed.**
- G. All piping over 6" in length shall have the manufacturers stenciling that is installed at the factory along the length of the pipe. The stenciling shall consist of the manufacturer's identifier (name or logo) at a minimum. Piping that does not contain the information described (i.e. no stenciling on black pipe, white dashes on black pipe, etc.) shall be assumed to be imported and shall be replaced at the Fire Protection Contractors expense. All exposed piping that is to be painted shall be visually inspected by the engineer prior to being painted.
- H. Mill Testing Reports (MTR's) shall be submitted to the Engineer prior to any pay requests for the fire protection sprinkler system installation being approved.
- I. The Fire Protection Contractor for each Fire Protection Specification Section of this project shall submit the information described in paragraph 4.01.A of this Specification Section after award of this contract.

1.03 COORDINATION

- A. The Fire Protection Contractor is responsible to initiate coordination meetings with the General Contractor. The General Contractor shall also involve the other Contractors needing to coordinate spatial requirements such as the Electrical Contractor, Mechanical Contractor, Plumbing Contractor, etc. as part of these coordination meetings.

- B. The Fire Protection Contractor shall participate in the on-site coordination meetings to coordinate the sprinkler system installation with the H.V.A.C. ductwork, H.V.A.C. units, plumbing piping, hydronic piping, and/or existing conditions.
- C. Coordination meetings shall consider elevations, required clearances, and routings of all trades to assure that all trades can be installed without conflict.
- D. The outcome of this coordination shall allow each system (Electrical, Mechanical, Fire Protection, Plumbing, etc.) to be installed without further conflicts for space or locations.
- E. Failure to coordinate with other trades and/or existing conditions that result in the removal and re-installation of systems shall not be charged as additional costs.
- F. The Fire Protection Contractor shall be responsible for documenting the date and participants of each coordination meeting and providing record copies of this documentation to the Engineer.

1.04 PIPE PENETRATIONS

- A. Provide pipe sleeves or core-drilled holes where piping passes entirely through concrete walls, floors, platforms, and foundations.
- B. Secure sleeves in position and location during construction and provide sleeves of sufficient length to pass through entire thickness of walls, floors, platforms, and foundations.
- C. Provide minimum clearances per N.F.P.A. #13 between exterior of piping and interior of sleeve or core-drilled hole.
- D. Firmly pack annular space with mineral wool insulation and seal both ends of the sleeve or core-drilled hole with plastic waterproof cement.
- E. Where piping passes through fire walls and fire floors, seal both end of pipe sleeves or core-drilled holes with U.L listed or Factory Mutual Global approved fill, void, or cavity material that maintains the fire resistance rating of the assembly being penetrated.
- F. Refer to Division 07 for requirements on sealing of penetrations.
- G. Requirements for utilizing pipe sleeves at penetrations.
 - 1. Sleeves in masonry and concrete walls, floors, platforms, and foundations: Provide hot-dip galvanized steel, ductile-iron, cast-iron, or PVC sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.
 - 2. Sleeves in other than masonry and concrete walls, floors, platforms, and foundations: Provide 26 gauge galvanized steel sheet material as a minimum thickness.
 - 3. Sleeve Sizing: A nominal diameter of 2" larger than the nominal diameter of the pipe is acceptable for pipe sizes 1" through 3½" and a nominal diameter 4" larger than the nominal diameter of the pipe is acceptable for pipe sizes 4" and larger.
 - 4. Clearance Omission: No clearance is necessary for piping passing through gypsum wallboard or equally frangible material that has no fire resistance rating or if flexible couplings are installed within 1'-0" of each side of the wall, floor, platform, or foundation.
- H. Requirements for utilizing core drilled holes at penetrations.
 - 1. Core Sizing: A diameter of 2" larger than the actual diameter of the pipe is acceptable for pipe sizes 1" through 3½" and a diameter 4" larger than the actual diameter of the pipe is acceptable for pipe sizes 4" and larger.

2. Clearance Omission: No clearance is necessary for piping passing through gypsum wallboard or equally frangible material that has no fire resistance rating or if flexible couplings are installed within 1'-0" of each side of the wall, floor, platform, or foundation.
- I. The Fire Protection / Mechanical drawings do not specifically identify penetrations through walls, floors, platforms, and foundations.
- J. The Fire Protection Contractor shall review all architectural and structural drawings to determine all penetration locations.
- K. All penetration locations through walls, floors, platforms, and foundations shall be coordinated with the General Contractor and all other trades.
- L. All penetrations through walls, floors, platforms, and foundations are the responsibility of the Fire Protection Contractor.

1.05 FIRE ALARM / ELECTRICAL CONNECTIONS

- A. The Fire Protection Contractor shall provide all new fire alarm devices associated with the fire protection system (flow switches, pressure switches, tamper switches, electric bells, etc.), as indicated on the contract documents.
- B. The electric bell and back box shall be provided by the Fire Protection Contractor, but shall be installed by the electrical Contractor.
- C. The low voltage electrical Contractor shall make all connections and terminations of the fire alarm devices to the fire alarm system control panel.
- D. All electrical work performed under this Section of the Specifications shall conform to all applicable portions of the Division 26 specifications and shall conform to all governing codes.
- E. Where a piece of equipment specified includes an electric motor, the motor shall be furnished and mounted by this Contractor. Motor starter, disconnect switches and wiring from the electrical panel to the motor control devices and to the motor shall be provided by the Division 26 Contractor unless stated otherwise in the fire protection specifications and on the fire protection drawings (schedules and/or notes).

1.06 SITE INSPECTIONS OF EXISTING SITE CONDITIONS PRIOR TO BIDDING

- A. The Fire Protection Contractor shall examine premises and understand the existing conditions that may affect performance of the Fire Protection Contractor's work of this Division before submitting proposals and/or bids for this work.
- B. No subsequent allowance for time or costs will be considered for any consequence related to failure to examine site conditions.
- C. Existing site conditions may not be fully depicted on the contract documents and is the bidding Fire Protection Contractor's responsibility to full understand the existing conditions of the project.

1.07 CONTRACT DOCUMENTS

- A. Fire Protection drawings may show general arrangement of exposed piping in critical or highly sensitive areas of the building. Follow as closely as actual building construction and work of other trades will permit.

- B. The Fire Protection Contractor shall be responsible for reviewing all contract documents such as architectural, civil, electrical, mechanical, plumbing, structural, specialty equipment, fire protection drawings, etc. These drawings could furnish information and/or details related to the design and construction of this project that requires additional fire protection that is not indicated on the fire protection contract documents. It is the Fire Protection Contractor's responsibility to review the design documents of all trades and to coordinate the design documents with the fire protection shop drawings.
- C. Architectural drawings take precedence over Fire Protection drawings. Additional notes affecting the fire protection sprinkler system design may be contained in the drawings of other trades.
- D. Because of small scale of fire protection drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- E. Where new piping locations are shown on the contract documents, the piping shall be designed and installed in a similar fashion, unless accepted by the design team. The Fire Protection Contractor is responsible for providing the required elbows, fittings, transitions, and offsets to accommodate structural members, architectural features, and coordination with other trade work.
- F. The fire protection system installation shall be made in accordance with the drawings, specifications, and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail, refer to Division 1.
- G. In the case that criteria contained on the drawings is omitted from the specifications or the specifications have criteria that is omitted from the drawings, the criteria given in one location shall apply as if shown in both the drawings and in the specifications (what's in one document applies to both documents). The drawings and specifications are complementary and what is called for in either is binding as if called for in both, see General Conditions of the Project Manual.
- H. The Fire Protection Contractor shall provide any work or materials the provision of which is clearly implied in the contract documents or project specifications, even if not specifically indicated.

1.08 SUBMITTALS

- A. Refer to "Request for Proposal" Section 01 33 00.01 for submittal procedures, and as noted herein.
- B. All material used on the project shall be new and free of defects.
- C. Provide copies as specified by Division 1 of shop drawings, calculations, and manufacturer's data sheets to the Engineer for approval prior to the purchase, fabrication, or installation of any system component. Failure to receive the Engineer approval that results in reordering of material, re-fabrication of piping, removal of installed system components, and the re-installation of the fire protection system shall not be charged as additional cost to the Port or General Contractor.
- D. A colored bond copy of the "Graphical Map" shall be presented to the Engineer for review and approval prior to final system testing.
- E. All items contained in the "Working Plans" section of the latest edition of N.F.P.A. #13 adopted by the Authority Having Jurisdiction shall be included as part of the submittal package.

- F. The information contained in the Equipment Submittals shall be grouped in an orderly arrangement by specification index. The Equipment Submittals shall have a typewritten index and divider sheets between categories with identifying tabs. The tabs shall be organized into the items described in the "Submittals" paragraph of each individual specification section associated with this project. The covers shall be imprinted with the name of the job, Port, Engineer, and Mechanical Contractor.
- G. Equipment Submittals shall contain original brochures supplied by manufacturers (Xerox copies of originals will only be accepted if they are clear and legible). Each type of device provided shall be identified in the Equipment Submittals using the same identification as shown on the drawings and specifications. The information included must be the exact equipment to be installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.
- H. Each fire protection specification section shall be tabbed individually with a master index at beginning of each section identifying all subsequent tabs indicating the divisions within each specification section that match the equipment submittal tab requirements contained within Part 1 of each fire protection sprinkler system specification system.
- I. Combining equipment submittals from multiple fire protection specification sections into a single equipment submittal will not be allowed.
- J. Submitting portions of the equipment submittals will not be accepted.
- K. If the submittals are being delivered electronically, the Fire Protection Contractor shall provide the following:
 - 1. Submittal Drawings:
 - a. The Submittal Drawings shall be a single PDF that is formatted to actual size (not 11x17) and collated in numerical order as designated in the title block of each drawing.
 - 2. Equipment Submittals:
 - a. The Equipment Submittal shall be a single PDF.
 - b. The Equipment Submittal PDF shall contain all equipment, devices, and components that are collated for printing on 8½"x11" sized paper.
 - c. The Equipment Submittal PDF shall be a searchable document.
 - d. The Equipment Submittal PDF shall be formatted for duplex printing with blank sheet inserted where necessary.
 - e. The Equipment Submittal PDF shall contain a "Table of Contents" that indicates all pieces of equipment, devices, and components contained within each "Tabbed Divider" defined in Paragraph 1.09.P of this Specification Section.
 - f. The Equipment Submittal PDF shall be bookmarked by "Tabbed Divider" and for each piece of equipment, device, and component.
 - g. Hydraulic Calculations and Seismic Brace Calculations that are submitted as part of the Equipment Submittal PDF shall be formatted to the following:
 - 1) Calculations shall be included at the end of the Equipment Submittal PDF under a separate "Tabbed Divider" for both Hydraulic Calculations and the Seismic Brace Calculations.

- 2) The Equipment Submittal "Table of Contents" shall also indicate all calculations being provided for both the Hydraulic Calculations and the Seismic Brace Calculations.
3. Hydraulic Calculations and Seismic Brace Calculations that are submitted as a separate PDF from the Equipment Submittal PDF:
 - a. The single Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall contain all calculations that are collated for printing on 8½"x11" sized paper.
 - b. The Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall be a searchable document.
 - c. The Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall be formatted for duplex printing with blank sheet inserted where necessary.
 - d. The Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall contain a "Tabbed Divider" to separate the Hydraulic Calculations from the Seismic Brace Calculations.
 - e. The Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall contain a "Table of Contents" that indicates all calculations contained within each "Tabbed Divider" defined in each Fire Protection Specification Section.
 - f. The Hydraulic Calculations and Seismic Brace Calculations submittal PDF shall be bookmarked by "Tabbed Divider" and for each Hydraulic Calculation and Seismic Brace Calculation.
4. Thrust Block Calculations:
 - a. The single Thrust Block Calculation submittal PDF shall contain all calculations that are collated for printing on 8½"x11" sized paper.
 - b. The Thrust Block Calculation submittal PDF shall be a searchable document.
 - c. The Thrust Block Calculation submittal PDF shall be formatted for duplex printing with blank sheet inserted where necessary.
 - d. The Thrust Block Calculation submittal PDF shall contain a "Tabbed Divider".
 - e. The Thrust Block Calculation submittal PDF shall contain a "Table of Contents" that indicates all calculations contained within each "Tabbed Divider" defined in Section 1.05 of Specification Section 21 11 23.01.
 - f. The Thrust Block Calculation submittal PDF shall be bookmarked by "Tabbed Divider" and for each Thrust Block Calculation.
- L. Review of submittal data by the Engineer does not relieve the Fire Protection Contractor of responsibility for quantities, measurements, and compliance with the intent of all contract documents.
- M. Any material found to be installed without prior approval will be required to be removed and replaced with only specified material at Contractor's cost.
- N. See each individual specification section associated with this project for the equipment submittals required.
- O. Submit qualifications of welders that meet or exceed American Welding Society (AWS) B2.1 "Standard Welding Procedures and Performance Qualifications" and Section IX of the ASME "Boiler and Pressure Vessel Code".

- P. Submit Welding procedures that comply with the qualification requirements of N.F.P.A. #13 and that meet or exceed American Welding Society (AWS) B2.1 "Standard Welding Procedures and Performance Qualifications" and SME Section IX of the ASME "Boiler and Pressure Vessel Code".
- Q. Submit the following items prior to substantial completion inspection for review and approval:
 - 1. Hydraulic Placards.
 - 2. General information Signs.
 - 3. Full Forward Flow Test Results Placard.
 - 4. List of Spare Sprinklers.

1.09 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Perform work in accordance with applicable Codes.
 - 2. In case of differences between building codes, state laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern.
- B. Product Approvals: See each individual specification section associated with this project for the prior approved products.
- C. Materials: **Use domestic made pipe, fittings, valves, hangers, sprinklers, and devices on this Project.**

1.10 CODES AND STANDARDS

- A. Codes and agencies having jurisdictional authority over Fire Protection installations.
 - 1. International Building Code -- Latest Adopted Edition
 - 2. International Fire Code – Latest Adopted Edition
 - 3. Local Water District Requirements
 - 4. State and County Department of Health
 - 5. Local Fire Marshal
 - 6. Occupational Safety and Health Administration (OSHA)
 - 7. Washington Industrial Safety and Health Act (WISHA)
 - 8. National Fire Protection Association (N.F.P.A.)
 - 9. Underwriters Laboratories (UL) Approval Guides

1.11 PRODUCT HANDLING AND PROTECTION

- A. Fire Protection Contractor is responsible for protection of all piping, fittings, and devices provided under this specification section free from damage, water, corrosion, rust, or foreign matter build up both in storage and when installed, until final project acceptance.
- B. Materials in the staging areas shall be protected by an approved means to prevent corrosion of the sprinkler system components. Failure to do so shall result in the material not being approved and if found installed will be replaced at the Fire Protection Contractor's expense.
- C. Equipment finish that is damaged by handling, storage, etc. shall be corrected by the Fire Protection Contractor at no additional cost to the Port.

- D. The Engineer reserve the right to reject any material, the appearance of which has been damaged on the site or in shipment.

1.12 WARRANTY LETTER

- A. In addition to the guarantee specified in General Conditions, the Fire Protection Contractor shall guarantee that the fire protection systems are installed to N.F.P.A. code and approved shop drawings.
- B. In order to be protected, secure proper guarantees from suppliers and any Sub-Contractors. Include all warranties/guarantees including extended warranties.
- C. Provide a "Certificate of Warranty" letter at the completion of the project. The date of "Substantial Completion" shall be clearly shown on the letter indicating when the warranty period begins and the "Certificate of Warranty" letter shall be signed by the Fire Protection Contractor.
- D. The "Certificate of Warranty" shall be included as part of the Operation and Maintenance Manual. The date of "Substantial Completion" shall be the date indicated on the approved test certificate that was signed by the Authority Having Jurisdiction for system acceptance.

1.13 TEST CERTIFICATES

- A. The following completed tests shall be contained as a minimum on "Test Certificates" provided to the Port at completion of this project.
- B. Water Based Sprinkler Systems
 - 1. Private Fire Service Mains
 - a. Underground lead-in hydrostatic testing
 - b. Underground purification testing
 - c. Underground lead-in flushing per N.F.P.A. #13 and N.F.P.A. #24 requirements
 - 2. Wet pipe automatic fire protection sprinkler system
 - a. Overhead hydrostatic testing
 - b. Overhead fire alarm connection point interface testing
 - c. Purification of piping on the potable side of the backflow preventer
 - d. Full forward flow testing of the backflow preventer
 - e. Backflow preventer certification testing
 - f. Main drain testing

1.14 AS-BUILT DRAWINGS

- A. The Fire Protection Contractor shall maintain, in addition to any reference drawings, an As-Built set of drawings, which have been reproduced from the approved site set on which all deviations from the original design shall be drafted in a neat legible manner with red colored pencil.
- B. The Fire Protection Contractor shall update all references to specific products to indicate products actually installed on project.
- C. Upon completion of work, the Fire Protection Contractor shall deliver the red lined drawings and one set of neatly drafted As-Built drawings to the Engineer for review.
- D. Submit full-scale drawings that are not larger than the contract documents (out of scale drawings will not be allowed)

- E. The As-Built drawings shall show actual installation from all change orders, field authorizations, design changes, installation modifications, etc.
- F. As-Built drawings shall contain dimensions to all main piping (from structure or gridlines), elevations of all piping (both above finished floor and below structure), and pipe length for all piping including riser nipples, sprigs, drops, and dry sprinkler heads.
- G. Schematic details provided on submittal drawings shall be changed to project specific details with all piping and devices sized and drawn to scale.

1.15 GRAPHICAL MAP

- A. The Fire Protection Contractor shall provide a "Graphical Map" in the main sprinkler system riser room for each building associated with this project and a "Graphical Map" to be placed in each of the Operations and Maintenance Manuals.
- B. The "Graphical Map" shall identify the locations of all of the following:
 - 1. Auxiliary Drain Valves
 - 2. Remote Inspector's Test Valves
 - 3. Auxiliary Control Valves
 - 4. Yard Post Indicating Valve (if installed as part of the project)
 - 5. Backflow Preventer in a vault (if installed as part of this project)
 - 6. Access Panels
 - 7. Main System Riser
 - 8. Automatic Air Vents
- C. The "Graphical Map" shall consist of the following items:
 - 1. Color representation of the building(s) floor plan.
 - a. Black: Building walls (interior and exterior)
 - b. Black: Building Gridlines (optional)
 - c. Black: "Graphical Map" title
 - d. Black: North Arrow
 - e. Black: Room Names and Room Numbers
 - f. Black: Text and leader lines that identify locations of all valves
 - g. Red: All horizontal sprinkler piping, elevation changes in piping are not required to be indicated on the "Graphical Map"
 - h. Cyan: All Acoustical Tile Ceilings
 - i. Blue: All Access Panels
 - 2. All text shall be a minimum of 3/32" in height and placed to not be superimposed over walls or sprinkler piping. The text shall be legible and clear utilizing leader lines to move text to a clear location.
 - 3. The "Graphical Map" shall be full color image printed on 8½"X11", 11"X17", or 24"X36" media, depending upon the size of the project and clarity of the information.

- D. The "Graphical Map" in the main sprinkler system riser room for each building associated with this project shall be laminated and securely fastened to the wall adjacent to the spare sprinkler head cabinet.
- E. The "Graphical Map" in each of the Operations and Maintenance Manuals shall be on bond paper and placed within a plastic sheet protector.

1.16 CLOSE OUT MATERIAL

- A. The fire protection close out material shall be submitted to the Engineer for review and approval.
- B. All close out materials shall be contained within a single 3-ring hard cover binder.
- C. The close out materials shall include the following at a minimum:
 - 1. Warranty Letters: See Paragraph 1.12 of this Specification Section for "Warranty Letter" requirements.
 - 2. Test Certificates: See Paragraph 1.13 of this Specification Section for "Test Certificate" requirements.
 - 3. As-Built Drawings: See Paragraph 1.14 of this Specification Section for "As-Built Drawing" requirements.
 - 4. Graphical Map: See Paragraph 1.15 of this Specification Section for "Graphical Map" requirements.

1.17 DEFINITIONS

- A. Thermal Envelope: The heat flow control layer (insulation for example) that separates the interior conditioned space from the exterior unconditioned space.
- B. Cold Space: Spaces outside of the building's thermal envelope in which ambient temperatures are expected to be below 40°F.
- C. Warm Space: Spaces within the building's thermal envelope in which ambient temperatures are not expected to be below 40°F.
- D. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- E. Unfinished Spaces: Spaces used for storage or work areas, such as sprinkler riser rooms, mechanical rooms, electrical rooms, etc., where appearance is not a factor.
- F. Exposed: Open to view i.e. a room that is not covered by other construction.
- G. Concealed Spaces: Spaces out of sight i.e. above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.
- H. Replace: All existing fire protection piping, fittings, hangers, seismic brace components, and heads shall be demolished and discarded from the project site. New fire protection piping, fittings, hangers, seismic brace components, and heads shall be installed in the "Scope of Work" areas indicated on the contract documents.
- I. Removed: All existing fire protection piping, fittings, hangers, seismic brace components, and heads identified on the contract documents shall be taken apart, taken down, and discarded from the project site. Removed items shall not be brought back to the project site for use or reinstallation.

- J. Reinstall: Existing fire protection piping, fittings, hangers, seismic brace components, and heads identified on the contract documents that are to be taken down and relocated to a new location for use.
- K. Trades: Work performed by General, Civil, Electrical, Fire Alarm, Fire Protection, Landscape, Mechanical, Plumbing, Structural. Kitchen and Stage Contractors.
- L. Soffit: A ceiling that is secondary to the primary ceiling elevation that is at a lower elevation and is finished with gypsum wall board or other construction materials.

1.18 ABBREVIATIONS

ABOC	"ABOVE BOTTOM OF CEILING" TO THE CENTERLINE OF SPRINKLER PIPING
AEG	ABOVE EXTERIOR GRADE
AFF	ABOVE FINISH FLOOR
AHJ	AUTHORITY HAVING JURISDICTION
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTM	AMERICAN SOCIETY OF TESTING & MATERIALS
ATOD	"ABOVE TOP OF DECK" TO THE CENTERLINE OF SPRINKLER PIPING
ATOJ	"ABOVE TOP OF JOIST" TO THE CENTERLINE OF SPRINKLER PIPING
AWWA	AMERICAN WATER WORKS ASSOCIATION
BFF	BELOW FINISH FLOOR
BHP	BRAKE HORSEPOWER
BOB	BELOW "BOTTOM OF BEAM" TO THE CENTERLINE OF SPRINKLER PIPING
BOC	BELOW "BOTTOM OF CEILING" TO THE CENTERLINE OF SPRINKLER PIPING
BOD	BELOW "BOTTOM OF DECK" TO THE CENTERLINE OF SPRINKLER PIPING
BOJ	BELOW "BOTTOM OF JOIST" TO THE CENTERLINE OF SPRINKLER PIPING
CH	CEILING HEIGHT
CPVC	CHLORINATED POLYVINYL CHLORIDE
EC	ELECTRICAL CONTRACTOR
FDC	FIRE DEPARTMENT CONNECTION
FM	FACTORY MUTUAL GLOBAL
GC	GENERAL CONTRACTOR
GPM	GALLONS PER MINUTE
HP	HORSEPOWER
IFOW	"INSIDE FACE OF WALL" TO THE CENTERLINE OF SPRINKLER PIPING
MC	MECHANICAL CONTRACTOR
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NPSH	NET POSITIVE SUCTION HEAD
NRS	NON RISING STEM
NTS	NOT TO SCALE
OFOW	"OUTSIDE FACE OF WALL" TO THE CENTERLINE OF SPRINKLER PIPING
OS&Y	OUTSIDE SCREW AND YOKE
PIV	POST INDICATOR VALVE
POC	POINT OF CONNECTION
PSI	POUNDS PER SQUARE INCH GAUGE PRESSURE
UFC	UNIFIED FACILITIES CRITERIA (U.F.C.)
UL	UNDERWRITER'S LABORATORIES

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. This Fire Protection Contractor shall provide completed systems with a neat and finished appearance. If, in the judgment of the Engineer, any portion of the work has not been performed in a workmanlike manner or is left in a rough unfinished state, the Fire Protection Contractor will be required to remove, reinstall, or replace same and patch and paint surrounding surfaces in a manner acceptable to the Engineer, without increase in cost to the Port.

3.02 CLOSEOUT SUBMITTALS

- A. Requirements: Final approval of fire protection installation will be recommended upon completion of the following:
 - 1. Completion of all punch list items
 - 2. Operation instruction period to Engineer's satisfaction
 - 3. Permit Submittal
 - 4. As-Built drawings on electronic media in AutoCAD 2013 format delivered to Engineer
 - 5. Signed Warranty Letter
 - 6. Operations and Maintenance Manuals
 - 7. Completed and Signed Test Certificates
 - 8. Backflow Preventer Full Forward Flow Test Certificate

3.03 FINAL INSPECTION

- A. Prior to acceptance of the fire protection work, the Fire Protection Contractor shall put all fire protection systems into operation for a period of not less than 5 working days so that they may be inspected by the Engineer.
- B. The time of the final inspection shall be mutually agreed to by the Port, Engineer, and Fire Protection Contractor.

3.04 OPERATION AND MAINTENANCE TRAINING

- A. Upon completion of the work, and after all tests and final inspection of the work by the Authority Having Jurisdiction (AHJ), the Fire Protection Contractor shall demonstrate and instruct the Port's designated operation and maintenance personnel in the operation and maintenance of the various fire protection systems.
- B. The Fire Protection Contractor shall arrange for scheduled instruction periods with the Engineer.
- C. The Fire Protection Contractor's representatives shall be Superintendents or Foremen knowledgeable in each system and Supplier's Representative when so specified.
- D. All drain locations and inspector's test locations shall be shown in addition to showing the access required to obtain the valves.
- E. A general description of each fire protection system shall be demonstrated including the following.
 - 1. Step-by-step procedure to follow shutting down each fire protection system.
 - 2. Step-by-step procedure to follow putting each fire protection system back into operation.
 - 3. Dry system air compressor locations and procedure for replacement.
- F. Scheduled instruction periods shall be based upon the complexity of the systems installed, but in no case be less than the following:

Underground Systems	1 Hour
Water Based Fire Protection Systems:	2 Hours for each system type
- G. Costs for time involved by the Fire Protection Contractor shall be included in the bid.

3.05 FIRE PROTECTION CONTRACTORS RESPONSIBILITY FOR NEW BUILDINGS

- A. The Fire Protection Contractor shall bear expense of cutting, patching, painting, repairing, and replacing of work of other trades that are required because of the Fire Protection Contractors fault, error, tardiness, or because of damage caused by the fire protection installation.
- B. All fire protection sprinkler system components, devices, and materials installed as part of this project shall be new and free of corrosion or rust.

3.06 INSTALLATION

- A. Install fire protection equipment to permit easy access for normal maintenance, and so that parts requiring periodic replacement or maintenance can be readily removed.
- B. Design and provide each system with full consideration to blind spaces, piping, electrical equipment, ducts, other construction, and equipment in accordance with detailed working drawings to be submitted to the Engineer for approval.
- C. The Fire Protection Contractor shall modify or relocate all items that interfere with access to other trade work.
- D. Provide access doors to access all valves installed in finished areas.
- E. If circumstances at a particular location make the accessible installation of an item difficult or inconvenient, the situation shall be discussed with the Engineer before installing the item in a poor access location.
- F. Provide separations between all dissimilar metals with a dielectric connection.

- G. Provide offsets around all electrical panels and similar electrical equipment (transformers, main distribution panels, etc.) to maintain the clear space required by N.F.P.A. #70 (National Electrical Code). A 6'-0" clear space is required above all electrical panels, a 6'-6" clearance is required from the floor to the top of the electrical panel, and a clear space of 3'-6" is required directly in front of the panel, except where indicated otherwise or required by N.F.P.A. #70 (National Electrical Code) to be more. Such offsets are typically not shown on the contract documents, but are required per this paragraph.
- H. All piping and related items installed by the Fire Protection Contractor shall not present a safety hazard (i.e., items installed at/near head height, items projecting into maintenance access paths, etc.) or it will be required to be relocated at no additional cost to the Port.
- I. Access to equipment is of utmost importance. The Fire Protection Contractor shall apply extra attention to the laying out of pipe and in coordinating all work. Poor access to other trade work equipment will not be accepted.
- J. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of contract documents.
- K. Install piping in longest reasonable lengths. The use of short lengths of pipe with multiple couplings where a single length of pipe could have been used is not acceptable.

PART 4 - CONTRACTORS

4.01 FIRE PROTECTION CONTRACTOR QUALIFICATIONS TO BID THIS PROJECT

- A. The Fire Protection Contractor shall submit the information contained in the "Fire Protection Contractor Qualifications Form" (3 pages) provided at the back of this Specification Section (as a minimum) after the award of the contract.
- B. The Fire Protection Contractor Qualifications shall be forwarded to the Architect/Engineer.
- C. Fire Protection Contractors that do not meet the minimum qualifications will not be allowed on the project.

END OF SECTION

FIRE PROTECTION CONTRACTOR QUALIFICATIONS FORM (PAGE 1 OF 3)

Item #1:

Project Name: _____

Item #2:

Company Name

Telephone Number

Address

E-Mail Address

Branch Office Address (If different)

Individual in Charge

Signature

Title

Item #3:

Date Company Opened: _____

Company History and past Name Changes (10 year minimum):

Item #4:

Attach a "Certificate of Insurance" showing a minimum of \$2,000,000 liability insurance.

FIRE PROTECTION CONTRACTOR QUALIFICATIONS FORM (PAGE 2 OF 3)

Item #5:

Provide project name, contact person, and contact number for the 5 most recent projects that your company has designed and installed that are similar in nature to this specific project.

Project #1: _____

Contact Person: _____ Phone Number: _____

Project #2: _____

Contact Person: _____ Phone Number: _____

Project #3: _____

Contact Person: _____ Phone Number: _____

Project #4: _____

Contact Person: _____ Phone Number: _____

Project #5: _____

Contact Person: _____ Phone Number: _____

Item #6:

Design must be by full time "in house" designers/engineers.

Provide documentation for a State of Washington Level III Certificate of Competency holder, a State of Washington Level U Certificate of Competency holder, and resumes of the designers/engineers to be working on this project for the dedicated fire protection underground work.

Provide documentation for a State of Washington Level III Certificate of Competency holder, NICET Level IV certification, and resumes of the designers/engineers to be working on this project for the sprinkler system work.

FIRE PROTECTION CONTRACTOR QUALIFICATIONS FORM (PAGE 3 OF 3)

Item #7:

To achieve maximum quality control of materials and to facilitate meeting project scheduling, second party fabrication (sub-contracted out) will not be allowed. All fabrication shall be performed "In House" and not at an outside fabrication shop. The Fire Protection Contractor's fabrication shop shall contain the following items to qualify as a legitimate fabrication shop and shall be indicated below.

	Yes	No
A full-time, in house, certified welder on staff that meets the requirements of American Welding Standards (AWS) B2.1 and N.F.P.A. #13.	<input type="checkbox"/>	<input type="checkbox"/>
Sample of testing reports to be given to owner, generated by the welder to certify the corresponding welds.	<input type="checkbox"/>	<input type="checkbox"/>
The fabrication shop includes a hanger shop for cutting of all hanger materials.	<input type="checkbox"/>	<input type="checkbox"/>
The fabrication shop contains a stationary (floor mounted) threading machine.	<input type="checkbox"/>	<input type="checkbox"/>
The fabrication shop contains a plasma cutter.	<input type="checkbox"/>	<input type="checkbox"/>
The fabrication shop contains a "make-on" machine.	<input type="checkbox"/>	<input type="checkbox"/>
Verification that the Fire Protection Contractor has accurately indicated the above information may be required.		

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
1. Section 21 00 00.01 - "General Fire Protection Requirements".
 2. Section 21 13 13.01 - "Wet Pipe Automatic Sprinkler Systems".

1.02 GENERAL

- A. Includes, but not limited to, the following:
1. Provide all material, labor, equipment, design, and services necessary to perform the installation of private fire service mains supplying an automatic sprinkler system, in accordance with the required and advisory provisions of the latest edition of N.F.P.A. #24 accepted by the Authority having Jurisdiction (City of Tacoma), and project specifications, except as modified herein.
 2. The Fire Protection Underground Contractor shall install the private service main(s) per the latest edition of N.F.P.A. #13 and N.F.P.A. #24 accepted by the Authority having Jurisdiction, from a point 5'-0" outside the building footing to the supply flange left approximately 6" above finished floor.
 3. The Fire Protection Underground Contractor shall obtain a permit and final approval from City of Tacoma for the private service main underground installation. All permits, fees for plan review, inspections, testing, etc. shall be included in the bid proposal.
 4. **The Fire Protection Underground Contractor shall simultaneously submit shop drawings and manufacturer's data sheets to the local Authority Having Jurisdiction and Engineer for review and shall be approved by the Engineer prior to the purchase, fabrication, or installation of any system component as detailed in Paragraph 1.05 of Specification Section 21 11 23.01. The Engineer submittal drawings shall be stamped and signed by the appropriate Contractors performing the design and installation of the fire protection underground supply.**
 5. **If another Contractor is performing the underground installation from the "point of connection" to a point 5'-0" outside of the buildings footing, it shall be submitted by that Contractor to the Engineer for review prior to any of the underground being purchased, fabricated, or installation of any system components.**
 6. All fire protection underground equipment installed shall be by a manufacturer contained within "PART 2 – PRODUCTS" of this specification unless prior approval has been received.
 7. Fire Protection Underground Contractor shall perform asphalt cutting, trenching, select fill, asphalt patching, and pipe restraining required for proper installation of the new private fire service main(s).
 8. **The Fire Protection Underground Contractor shall provide a copy of the "Underground Test Certificate" to the Engineer for review and shall be approved by the Engineer prior to the overhead fire protection piping being connected to the underground piping. The "Test Certificate" shall be completely filled out and shall indicate the method used for flushing, standard the system was flushed in**

accordance with, and shall be signed by the Authority having Jurisdiction who witnessed the flushing test.

1.03 GENERAL SYSTEM REQUIREMENTS

- A. The Fire Protection Underground Contractor shall coordinate with a locate company prior to beginning any excavation work. The Fire Protection Underground Contractor shall include all fees associated with the "locate" in the bid.
- B. The underground supply piping shall be provided with a concrete thrust block at all changes of direction and at the elbow where the pipe turns from a horizontal installation to vertical installation.
- C. The elbow located under the building on the fire protection underground supply piping shall also be provided with rodding as a second means of restraint. The elbow shall be rodded to the flange above finished floor in the vertical direction and rodded to the first joint outside of the buildings footing in the horizontal direction.
- D. The minimum Fire Protection Underground supply pipe size shall be 4", but shall be based upon the hydraulic calculation demands of the fire protection system being installed in the building by the project fire protection engineer.
- E. The Fire Protection Underground supply piping shall:
 - 1. Be installed a minimum of 1'-0" below the bottom of the foundation / footing to the top of the piping.
 - 2. Be installed a maximum distance of 10'-0" from the outside edge of foundation / footing to the centerline of the vertical supply piping penetrating the floor slab.
- F. If allowed by the local Authority Having Jurisdiction, the minimum depth of cover shall be no less than 3'-0" at finish grade. Otherwise, the minimum depth of cover shall be based upon Figure A.10.4.1 of the 2013 edition of N.F.P.A. #13 and N.F.P.A. #24, with the minimum depth of cover being no less than 4'-0" at finish grade.
- G. The underground piping shall terminate with a flange left 6" above finished floor.
- H. The supply flange shall be two-holed with respect to the back wall (the two closest flange holes to the back wall shall be at the same distance from the back wall) to assure that the sprinkler system riser will be aligned parallel with the back wall.

1.04 SUBMITTALS

- A. See Specification Section 21 00 00.01 Paragraphs 1.08 for "Submittal" requirements.
- B. Product substitution during installation from the approved Equipment Submittals will not be allowed and shall result in the removal and re-installation of system components at no additional cost to the Port.
- C. Equipment submittal tabs shall include, at a minimum, the following:
 - 1. Piping.
 - 2. Fittings / Couplings.
 - 3. Miscellaneous Equipment.
- D. Equipment submittals shall include, at a minimum, the following:
 - 1. Piping (Potable and Non-Potable).
 - 2. Couplings / Fittings (Flanged, Grooved, Mechanical Joint, Etc.).

3. Buried Utility Warning and Identification Tape.
- E. All re-submitted drawings shall have the areas of revision clearly marked with revision clouds.
- F. When the drawings are created in AutoCAD, the submittal drawings shall be in plotted to the following criteria:
 1. Black and white plots shall consist of the following as a minimum:
 - a. Light Black for drawing background.
 - b. Dark Black for all underground related components and text.

1.05 QUALIFICATIONS

- A. Section 212.80.018(2)(a)(iii) of the "Washington Administrative Code" (WAC) requires a State of Washington Level 3 Certificate of Competency holder or Section 212.80.015(2)(d) of the "Washington Administrative Code" (WAC) requires a registered professional engineer in the State of Washington to prepare the layout drawings for the fire protection work.
- B. Section 212.80.018(2)(b)(i) of the "Washington Administrative Code" (WAC) requires a State of Washington Level U Certificate of Competency holder to perform the fire protection underground piping installation.
- C. The installing Fire Protection Underground Contractor shall have a minimum of five (5) year's experience in the design, installation and testing of private fire service mains.

1.06 PIPING SYSTEM LAYOUT

- A. Prepare detailed working drawings that are not larger than the contract documents for the system layout in accordance with N.F.P.A. #13, "Working Drawings (Plans)". Show data essential for the proper installation of each fire protection underground system per N.F.P.A. #13 and N.F.P.A. #24.
- B. The cover sheet of the shop drawings shall contain a site plan (1" = 50'-0" minimum) that clearly shows all fire service main routing with size and type of pipe indicated, fire hydrant locations, fire department connection location, devices, valves, and fittings, regardless of who performed the underground work.
- C. A graphical scale shall be provided for each floor plan or detail on the shop drawings in accordance with N.F.P.A. #13, "Working Drawings (Plans)".
- D. The minimum text size on full scale drawings shall be 1/8" high.
- E. The cover sheet of the shop drawings shall clearly state the scope of Contractor's work, Contractor's exclusions, Contractor's start point, which version of N.F.P.A. #13 and N.F.P.A. #24 was used for the private fire service main design, and current water flow information.

1.07 UNDERGROUND SYSTEM VELOCITY REQUIREMENTS

- A. The maximum velocity allowed in the underground mains shall be 8 feet per second and the maximum velocity allowed through the backflow preventer shall be 16 feet per second maximum.

1.08 UNDERGROUND MAXIMUM PRESSURE LOSS REQUIREMENTS

- A. The pressure loss associated with the fire protection underground supply shall not exceed 5.0 p.s.i. over the length of the entire dedicated underground supply piping. The pressure loss of the underground piping shall be based upon the flows of the sprinkler system demands and all interior hose stream requirements.

PART 2 - PRODUCTS

2.01 PRIVATE FIRE SERVICE MAIN PIPING SYSTEMS

- A. All fire protection system components, devices, and materials installed as part of this project shall be new.
- B. **All fire protection underground components and devices shall be domestically manufactured. Imported components will not be allowed.**

2.02 PRIVATE FIRE SERVICE MAIN PIPE AND FITTINGS

- A. All underground system piping and fittings shall meet the following criteria:
 - 1. Underground Supply Piping from a point 5'-0" Outside the Building Footing to the Supply Flange Left Approximately 6" Above Finished Floor: Provide cement mortar lined Class 52 ductile iron piping. All fittings shall be U.L. listed, or F.M. approved for fire protection installations, shall utilize full flow standard radius fittings, and shall match the type of underground piping to be installed.
 - 2. Approved manufacturers are as follows:
 - a. Flanged Products: American Cast Iron Pipe Company, Anvil International, Merit Manufacturing (Mueller), Trinity Valley Iron & Steel Company, Pacific Coast Flange Incorporated, Tyler Pipe, Union Foundry Company, U.S. Pipe and Foundry Company, Ward, or prior approved equal.
 - b. Mechanical Joint Fittings and Retainer Glands: American Cast Iron Pipe Company, Ford Meter Box Company, Tyler Pipe, U.S. Pipe and Foundry Company, or prior approved equal.
 - c. Ductile Iron Pipe: American Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or prior approved equal.
 - d. Mechanical Joint Products: American Cast Iron Pipe Company, EBBA Iron Incorporated, Pacific States Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or prior approved equal.

2.03 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

- A. Provide electronically detectable aluminum foil plastic backed tape or electronically detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping.
- B. Provide identification tape that has a 3" minimum width roll, a minimum of 4 mil thick, and color coded for the utility involved. Identification tape shall have bold black letters imprinted with "CAUTION BURIED WATER PIPING BELOW" or similar wording continuously and repeatedly over entire tape length.
- C. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.
- D. Approved manufacturers are as follows:
 - 1. Buried Utility Warning and Identification Tape: Pro-Line Safety Products Company, Tek Identification Products, or prior approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF UNDERGROUND PIPING SYSTEMS

- A. A list of installations of a similar nature and scope shall be provided on request.

- B. The Fire Protection Underground Contractor shall be responsible for the design, material, fabrication, workmanship, assembly, examination, testing, and certification that the underground installation meets local and N.F.P.A. codes.
- C. The Fire Protection Underground Contractor shall remove and replace any piping joints deemed improperly installed or show signs of leakage.

3.02 FLUSHING OF UNDERGROUND PIPING

- A. Flush piping with potable water in accordance with N.F.P.A. #13 and N.F.P.A. #24 at a minimum velocity of 10 feet per second.
- B. Flow for Class 52 Ductile Iron piping shall be at least 290 g.p.m. for 3" pipe, 440 g.p.m. for 4" pipe, 970 g.p.m. for 6" pipe, 1,725 g.p.m. for 8" pipe, 2,650 g.p.m. for 10" pipe, and 3,800 g.p.m. for 12" pipe.
- C. Continue flow for a sufficient time to ensure thorough cleaning.

3.03 PURITY TESTING OF PIPING INSTALLED BEFORE BACKFLOW PREVENTION DEVICE

- A. Disinfect the new water supply piping affected by Fire Protection Underground Contractor's operations in accordance with the health authority, water purveyor having jurisdiction and AWWA C651.
- B. Exercise caution when mixing chlorine disinfectant solutions.
- C. Fill piping systems or piping affected by Fire Protection Underground Contractor's operations with solution containing a minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours or use a solution containing a minimum of 200 parts per million of chlorine and allow solution to stand for minimum of 3 hours.
- D. Following the required standing time, the piping shall be flushed with clean potable water until the maximum residual chlorine content is not greater than that of the domestic water supply or 0.2 part per million.
- E. Have a certified laboratory analyze the results from two consecutive satisfactory bacteriological samples and submit these results before the piping is placed into service.
- F. Purity testing of piping supplied by non-potable water sources will not be required.

3.04 WIRE AND MARKING TAPE TO LOCATE PIPING

- A. Install marking tape at an elevation approximately 1'-0" above the underground piping. Install a continuous 12 gauge copper wire (where required by the Authority Having Jurisdiction) to the topside of all underground piping.

3.05 HYDROSTATIC TEST

- A. Hydrostatically test each system at 200 P.S.I. or 50 P.S.I. in excess of the systems working pressure (whichever is greater), for a 2-hour period.
- B. The amount of leakage at the joints shall not exceed (2) quarts per hour per (100) gaskets or joints irrespective of pipe diameter.
- C. The amount of leakage shall be increased by (1) fluid ounce per inch valve diameter per hour for each metal seated isolating the test section.
- D. When tests have been completed and corrections made, submit a signed and dated certificate similar to that specified in N.F.P.A. #13 and N.F.P.A. #24.

3.06 INITIAL BACKFILL MATERIAL

- A. See Civil Specifications.

3.07 OFFSITE SOILS REQUIREMENTS

- A. See Civil Specifications.

3.08 INITIAL BACKFILLING AND COMPACTION

- A. See Civil Specifications.

3.09 FINAL BACKFILLING AND COMPACTION

- A. See Civil Specifications.

3.10 DISPOSITION OF SURPLUS MATERIAL

- A. See Civil Specifications.

3.11 FORMAL TESTS AND INSPECTIONS

- A. Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved.
- B. Submit a written request to local fire protection authority for formal inspection at least 15 days before the inspection date.
- C. An experienced technician regularly employed by the system installer shall be present during the inspection.
- D. At this inspection, repeat any or all of the required tests as directed.
- E. Correct defects in work provided by the Fire Protection Underground Contractor and make additional tests until the system(s) comply with contract requirements.
- F. Furnish appliances, equipment, electricity, instruments, connecting devices and personnel for the tests.
- G. The Port will furnish water for the tests.
- H. Furnish Engineer with three (3) copies of certificates required by testing agencies.

3.12 TRAINING PERIOD

- A. Upon completion of the work and after all tests and inspections by the authority(s) having jurisdiction, the Fire Protection Underground Contractor shall demonstrate and train the Port's designated operation and maintenance personnel in the operation and maintenance of the fire protection system.
- B. The Fire Protection Underground Contractor shall arrange scheduled instruction periods with the Port's designated operation and maintenance personnel.
- C. The Fire Protection Underground Contractor's representatives shall be superintendents or foremen who are knowledgeable in each system and suppliers representatives when so specified.
- D. Scheduled training periods shall be based upon complexity of the system installed, but in no case be less than indicated in Paragraph 3.03 of Specification Section 21 00 00.01.
- E. Upon request of the Port, a DVD of the training period shall be made available by the Fire Protection Underground Contractor at no additional cost to the Port.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 21 00 00.01 - "General Fire Protection Requirements".
 - 2. Section 21 11 23.01 - "Private Fire Service Mains".

1.02 GENERAL

- A. Includes, but not limited to, the following:
 - 1. Provide all material, labor, equipment, design, and services necessary to perform the installation of (1) wet pipe automatic fire protection sprinkler system for complete fire protection coverage throughout, in accordance with the required and advisory provisions of the latest edition of N.F.P.A. #13 accepted by the Authority having Jurisdiction (City of Tacoma), and project specifications, except as modified herein.
 - 2. The Fire Protection Sprinkler System Contractor shall obtain a permit and final approval from City of Tacoma for the fire protection sprinkler system. All permits, fees for plan review, inspections, testing, etc. shall be included in the bid proposal.
 - 3. **The Fire Protection Sprinkler System Contractor shall simultaneously submit shop drawings, hydraulic calculations, seismic bracing calculations, and manufacturer's data sheets to the local Authority Having Jurisdiction and Engineer for review and shall be approved by the Engineer prior to the purchase, fabrication, or installation of any system component as detailed in Paragraph 1.12 of Specification Section 21 13 13.01.**

1.03 GENERAL SYSTEM REQUIREMENTS

- A. Notify the Engineer, Fire Protection Engineer, General Contractor, and building Owner to coordinate the pre-design meeting stated in Specification Section 21 00 00.01 Paragraph 1.02.E, if the Fire Protection Sprinkler System Contractor decides a pre-design meeting is warranted.
- B. The sprinkler riser detail shown on the contract documents is conceptual in nature with the minimum quantity and types of sprinkler risers being required for this project. Actual quantity and types of system risers required for this project shall be determined by the Fire Protection Sprinkler System Contractor meeting the requirements of this specification. If additional system risers are necessary, the Fire Protection Sprinkler System Contractor shall include them in their scope of work, prior to bidding.
- C. A table shall be placed adjacent to the fire protection sprinkler system riser detail that indicates the actual "Floor Area" protected by each system riser on each floor of the building it serves.
- D. Devices and equipment for fire protection service shall be U.L. listed or Factory Mutual Global approved for use in wet pipe sprinkler systems.
- E. **All H.V.A.C. mechanical units and associated ductwork larger than 10" shall be shown on the sprinkler shop drawings as part of the backgrounds.**
- F. All H.V.A.C grilles, electrical lights, and fire alarm devices that are to be installed at the ceiling level shall be shown on the submittal drawings to verify sprinkler head placements.

1.04 LOCATION OF SPRINKLER HEADS

- A. Sprinkler heads located in acoustical ceiling tiles shall be installed in a consistent pattern, centered both directions within the ceiling tiles (12" from a ceiling grid), and placed to avoid all lights, air diffuser grilles, and obstructions.
- B. Sprinkler heads located in rooms that contain entire gypsum wallboard ceilings shall be installed in a consistent pattern within the gypsum wallboard ceiling and placed to avoid all surface mounted lights, air diffuser grilles, and obstructions.
- C. Sprinkler heads located in soffits shall be installed in a consistent pattern and placed to avoid all lights (surface mounted and/or recessed), air diffuser grilles, and obstructions.
- D. Sprinkler heads in exposed areas shall be installed in a consistent pattern while avoiding all lights, ductwork, and structural members.
- E. All semi-recessed sprinkler heads shall be installed in such a manner that the deflector distance shall be within ½" of each other as measured from the ceiling. Sprinkler heads that are determined to be installed outside of this installation range shall be modified to meet these criteria.
- F. All semi-recessed sprinkler heads shall be installed in such a manner that the center part of the escutcheon that is attached to the sprinkler head does not protrude beyond the trim ring that conceals the ceiling or wall penetration.
- G. All pendent sprinkler heads with 2-piece escutcheons shall be installed in such a manner that the deflector distances shall be within ½" of each other as measured from the ceiling. Sprinkler heads that are determined to be installed outside of this installation range shall be modified to meet these criteria.
- H. Sprinkler heads shall be installed within all ceiling pockets except when all of the following criteria of N.F.P.A. #13 are met:
 - 1. The total volume of the unprotected ceiling pocket does not exceed 1,000 cubic feet.
 - 2. The depth of the unprotected pocket does not exceed 3'-0".
 - 3. The entire floor under the unprotected ceiling pocket is protected by sprinklers at the lower ceiling elevation.
 - 4. Each unprotected ceiling pocket is separated from any adjacent unprotected ceiling pocket by a minimum 10'-0" horizontal distance.
 - 5. The unprotected ceiling pocket is constructed of non-combustible or limited combustible construction.
 - 6. Quick response sprinkler heads are utilized throughout the compartment.
- I. All semi-recessed and pendent sprinkler heads installed below a ceiling within each room shall have the frame arms aligned parallel to each other. Multiple heads installed in a single room shall not be allowed to have the frame arms not parallel to each other.
- J. All upright sprinkler heads shall be installed with the frame arms parallel to the branch line.
- K. The "Area of Coverage" per sprinkler head installed beneath roll back garage style doors shall be based upon the occupancy classification of the floor area beneath the roll back garage style door, not Light Hazard Occupancy as indicated by N.F.P.A. #13.

- L. Spacing of sprinkler heads shall not exceed that permitted by N.F.P.A. #13 for occupancy, except where the Fire Protection Sprinkler System Contractor elects to utilize extended coverage sprinklers.

1.05 WATER DISTRIBUTION

- A. Sprinkler head discharge shall be uniform throughout the area in which the sprinkler heads will open. Discharge from individual heads in the hydraulically most remote area shall be at a minimum of 100% the specified density.

1.06 SPRINKLER DENSITY AND DISCHARGE AREA OF OPERATION

- A. Size piping to provide the required density when the system is discharging over the entire most demanding area.
- B. Using the "Pipe Schedule" method to determine pipe sizing will not be allowed.
- C. Basing hydraulic calculations upon the "Room Design" method to determine pipe sizing will not be allowed.
- D. Application rates to horizontal surfaces below the sprinklers (floor area) shall be 0.10 g.p.m. per square feet over the hydraulically most demanding 1,500 square feet for light hazard occupancy (combustible ceiling voids, combustible attic spaces, Foreman Offices, Break Rooms, Men's Restroom, Stairs, Women's Restroom, Women's Lounge, Super Cargo Offices, Clerk I, Clerk II, Superintendents, Corridor, and dry sprinkler coverage under exterior canopies or overhangs).
- E. Application rates to horizontal surfaces below the sprinklers (floor area) shall be 0.15 g.p.m. per square feet over the hydraulically most demanding 1,500 square feet for ordinary hazard group I occupancy (Janitor's Rooms, Kitchenette and IT Room).
- F. Application rates to horizontal surfaces below the sprinklers (floor area) shall be 0.20 g.p.m. per square feet over the hydraulically most demanding 1,500 square feet for ordinary hazard group II occupancy (Fire Sprinkler Rooms, Mechanical Areas, Elevator Panel Closet, Elevator Shafts, and Copy/Work Room).
- G. A reduction in remote area may be used where quick response sprinkler heads are utilized in light or ordinary hazard occupancy where there are no unprotected ceiling pockets and the maximum ceiling height is 20'-0".
- H. When sloped ceilings or roofs are present and the slope exceeds 2" per foot, the remote area shall be increased by 30%.
- I. For buildings having unsprinklered combustible spaces (including areas used for roof venting), the minimum area of sprinkler operation shall be 3,000 square feet after all other remote area modifications have been made.

1.07 HOSE STREAM ALLOWANCES

- A. Hose stream allowances for hydraulic calculations shall be per N.F.P.A. #13.
- B. Light hazard occupancy shall require 100 g.p.m. combined hose streams.
- C. Ordinary hazard occupancy shall require 250 g.p.m. combined hose streams.

1.08 PIPE C-VALUES FOR CALCULATING FRICTION LOSSES

- A. Calculate losses in piping in accordance with Hazen-Williams equation using a 'C' value of:
 - 1. 100 for unlined cast iron or unlined ductile iron.

2. 120 for black steel wet systems or galvanized steel wet systems.
3. 140 for cement lined cast iron, cement lined ductile iron, asbestos cement, or concrete.

1.09 WATER SUPPLY

- A. Base hydraulic calculations (for the bid) on a flow test performed on October 2, 1995 of 98 p.s.i. static pressure with a residual pressure of 87 p.s.i. while flowing 4,378 g.p.m. Test hydrant elevation is approximately 4.0 feet (from Google Earth) and is located at the intersection of Ashton Way and Port of Tacoma Road. Flow test information provided by the City of Tacoma Water Department.
- B. After award of the project, the Fire Protection Sprinkler System Contractor shall verify available water supply with a flow test recorded within six months of bid date. If a new flow test is required, the Fire Protection Sprinkler System Contractor shall coordinate with local authorities for a new flow test and the fees associated with a new flow test shall be included in the bid. Information obtained from this flow test and indicated on the drawings shall be: test hydrant static pressure, test hydrant residual pressure, associated pitot reading from flowing hydrant, test hydrant location, test hydrant elevation, and underground water main configuration.

1.10 PIPE HANGER DETAILS

- A. Provide pipe hanger details and seismic bracing details in strict accordance with N.F.P.A #13 and manufacturer's literature.
- B. Details shall be unique to each installation configuration with all components clearly identified including the means of attachment and structure to be attaching to.
- C. For all trapeze hangers, provide a table indicating the size of the pipe to be supported, size and type of the trapeze member, section modulus of the trapeze member, distance from the structure to pipe being supported (A and B dimensions), and the section modulus required.

1.11 SEISMIC BRACING

- A. Calculations.
 1. Seismic brace calculation requirements shall be based upon Section 1613.1 of the 2012 Edition of the International Building Code (I.B.C.) and Chapter 13 of ASCE 7-10.
 2. The "General Notes" sheets for the structural drawings contained in the contract documents define the "Seismic Design Category" for this project.
 3. Per Section 13.6.8.2 of ASCE 7-10, fire protection sprinkler piping, pipe hangers, and bracing designed and constructed in accordance with N.F.P.A. #13 shall be deemed to meet the force and displacement requirements of this section.
 4. Provide seismic calculations for each seismic brace configuration showing the total calculated load, size of bracing material, type of bracing material, length of bracing material, seismic brace design angle, allowable load of the bracing component, allowable horizontal bracing load of the sprinkler system, structure for bracing connection, size of fastener, length of fastener, allowable load per fastener, and the number of braces required.
 5. Each seismic brace configuration shall have a unique identifier associated with the calculation to easily and readily identify which seismic brace calculation it is.
 6. Seismic bracing members for connections to structural members shall be sized per assigned load tables in N.F.P.A. #13 with a maximum L/R ratio of 200.

7. **The "Total Calculated Load" divided by the "Allowable Load per Fastener" shall not exceed a maximum value of 0.90.**

B. Drawings.

1. The submittal drawings shall identify the "Zone of Influence" for each seismic brace configuration that is provided with a seismic brace calculation.
2. The submittal drawings shall identify each seismic brace on the submittal drawings by the same unique identifier indicated in the seismic brace calculations to easily and readily cross reference the seismic brace calculation associated with that particular seismic brace.

C. Details.

1. Seismic bracing details may be incorporated into the seismic bracing calculations to form a single detail for each brace configuration.
2. The seismic brace details shall identify the seismic brace member, length of brace member, angle of brace member installation, the structural member the seismic brace is attaching to, the fastener to be utilized, and all seismic brace components by Manufacturer and model number.

1.12 SUBMITTALS

- A. See Specification Section 21 00 00.01 Paragraphs 1.08 for "Submittal" requirements.

- B. Sprinklers shall be referred to in the equipment submittals by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

- C. Equipment submittal tabs shall include, at a minimum, the following:

1. Piping.
2. Fittings / Couplings.
3. Sprinkler Heads and Accessories.
4. Backflow Preventers.
5. Fire Department Connections.
6. Valves.
7. Electrical / Fire Alarm Components.
8. Pipe Hangers.
9. Seismic Bracing Components.
10. Access Doors.
11. Miscellaneous Equipment.

- D. Equipment submittals shall include, at a minimum, the following:

1. Piping (Potable and Non-Potable).
2. Fittings / Couplings (Flanged, Grooved, Threaded, Etc.).
3. Sprinkler Heads / Head Guards.
4. Backflow Preventers.
5. Fire Department Connections.

6. Hose Valves for Full Forward Flow testing of the Backflow Preventer.
 7. Valves.
 8. Shotgun Riser Assemblies.
 9. Local Alarm Device (Electric Bell).
 10. Flow Switches.
 11. Tamper Switches.
 12. Inspector's Test Assemblies.
 13. Adjustable Drop Nipples.
 14. Flexible Piping Serving Pendent Sprinkler Heads.
 15. Pipe Hangers.
 16. Seismic Bracing Components.
 17. Pressure Relief Valves.
 18. Water Pressure Gauges.
 19. Automatic Air Vents.
 20. Access Doors.
- E. All re-submitted drawings shall have the areas of revision clearly marked with revision clouds.
- F. When the drawings are created in AutoCAD, the submittal drawings shall be in plotted to the following criteria:
1. Black and white plots shall consist of the following as a minimum:
 - a. Light Black for drawing background.
 - b. Dark Black for all sprinkler related components and text.

1.13 QUALIFICATIONS

- A. Section 212.80.018(2)(a)(iii) of the "Washington Administrative Code" (WAC) requires a State of Washington Level III Certificate of Competency holder or Section 212.80.015(2)(d) of the "Washington Administrative Code" (WAC) requires a registered professional engineer in the State of Washington to prepare the layout drawings for the fire protection work.
- B. Only a designer that is certified as a Level III technician by National Institute for Certification in Engineering Technologies (NICET) in the automatic sprinkler system layout sub field of fire protection engineering technology (in accordance with NICET 1014-7) shall be allowed to perform the fire protection work on this project.
- C. The installing Fire Protection Sprinkler System Contractor shall have a minimum of five (5) years experience in the design, installation, and testing of wet pipe automatic fire protection sprinkler systems, or similar fire protection systems. A list of installations of a similar nature and scope shall be provided on request.

1.14 PIPING SYSTEM LAYOUT

- A. Prepare detailed working drawings that are not larger than the contract documents for the system layout in accordance with N.F.P.A. #13, "Working Drawings (Plans)". Show data essential for the proper installation of each fire protection sprinkler system per N.F.P.A. #13

- consisting of floor plans (1/8" = 1'-0" minimum), building sections, piping details, and elevations to clearly show pipe routing, head spacings, system water supply, devices, valves, and fittings.
- B. The cover sheet of the shop drawings shall contain a site plan (1" = 50'-0" minimum) that clearly shows all fire service main routing with size and type of pipe indicated, fire hydrant locations, fire department connection location, devices, valves, and fittings, regardless of who performed the underground work.
 - C. A graphical scale shall be provided for each floor plan or detail on the shop drawings in accordance with N.F.P.A. #13, "Working Drawings (Plans)".
 - D. The minimum text size on full scale drawings shall be 1/8" high.
 - E. The cover sheet of the shop drawings shall clearly state the scope of Contractor's work, Contractor's exclusions, Contractor's start point, sprinkler system design criteria, which version of N.F.P.A. #13 was used for the sprinkler design, sprinkler system design density, remote area size for all occupancies, and current water flow information used in the hydraulic calculations.
 - F. Projects that require more than one sheet to show the entire fire protection sprinkler system shall require a key plan.
 - G. The key plan shall be located in the lower right hand corner of the drawing, shall identify the location of the fire protection sprinkler system that is contained on that sheet, and shall contain a reference north arrow.
 - H. All sheets shall contain a "Matchline" designation to indicate where the building and fire protection sprinkler system continues, even if on the same sheet.
 - I. All flexible grooved couplings that are to be installed shall be designated on the drawings and shall meet the requirements of N.F.P.A. #13 for vertical and horizontal pipe runs.
 - J. Sprinklers shall be referred to in the sprinkler legend by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

1.15 SPRINKLER SYSTEM DESIGN

- A. Hydraulic calculations for the fire protection sprinkler system design are to be based upon the area/density method.
- B. Hydraulic calculations for all tree type, looped type, and gridded type sprinkler systems shall be performed on a computer utilizing an approved fire protection hydraulics program.
- C. Tree type sprinkler systems may utilize "Excel" to perform the hydraulic calculations.
- D. Hydraulic calculations performed by hand will not be accepted.
- E. Small rooms (closets, restrooms, etc.) contained within the remote area shall be included in the hydraulic calculations. Omission of small rooms will not be allowed.
- F. 1" piping shall not serve (2) upright or (2) pendent sprinkler heads unless hydraulic calculations are provided to verify the pressure losses associated with multiple flows through 1" pipe.
- G. An equivalent length of 1'-0" shall be added to the hydraulic calculations for each roll groove installed on the piping and shall be added to the pipe containing the roll groove.
- H. An equivalent length of pipe for flexible piping drops (manufacturer's submittal literature) shall be added to the hydraulic calculations, shall be added to the pipe containing the flexible sprinkler drop, and shall be based upon the U.L. listed equivalent lengths documented in the manufacturer's submittal literature.

- I. All changes in piping elevation shall be reflected in the hydraulic calculations at the point in which the elevation change occurs. Adding an accumulated total for elevation at a single point will not be allowed.
- J. A margin in the hydraulic calculations shall be maintained between the system demands and water availability. The margin shall consist of 5 p.s.i. or 10% depending upon whichever is greater and is based upon the available static pressure.
- K. Hydraulic node numbers shall be unique for each remote area, shall not be duplicated for auxiliary remote areas, shall not be duplicated for other sprinkler systems installed as part of this project, and shall be shown on the submittal drawings.
- L. Hydraulic node numbers shall be unique for each reference point and only used once per system. A common reference point for multiple hydraulic calculations shall only have one hydraulic node designation, multiple references to the same hydraulic reference point will not be accepted.
- M. An equivalent "K-factor" for sprinkler head drops or sprigs (stub-ups) will not be acceptable. The actual "K-factor" of the sprinkler head, associated lineal pipe footage, equivalent lineal footage for associated pipe fittings, and elevations shall be part of the main body of the hydraulic calculations. Separate one line calculations to determine an equivalent "K-factor" that is inserted into the hydraulic calculations will not be acceptable.

1.16 SPRINKLER SYSTEM VELOCITY REQUIREMENTS

- A. Maximum permissible velocity in branch lines 2" and less in gridded systems shall be 20 feet per second.
- B. Maximum permissible velocity in tree-type branch lines and mains shall be 26 feet per second.
- C. The maximum velocity in the piping containing a vane type water flow detector shall be 18 feet per second.
- D. The maximum velocity allowed in the underground mains shall be 8 feet per second.
- E. The maximum velocity allowed through the backflow preventer shall be 16 feet per second maximum.

1.17 SPRINKLER SYSTEM CONTROL VALVE REQUIREMENTS

- A. Provide a control valve loop for piping serving elevator pits, elevator mechanical rooms, or sprinklers at the top of elevator shafts in the location indicated on the contract documents.
- B. The control valve loop shall consist of a grooved coupling on the supply side of the control valve and shall contain a grooved coupling on the discharge side of the control valve.
- C. The control valve piping shall also contain an auxiliary drain outlet with a ball valve.
- D. The drain discharge shall be piped to an acceptable location and shall not terminate in the wall.
- E. The control valve piping serving elevator pits, elevator mechanical rooms, or sprinklers at the top of elevator shafts shall be concealed in an interior wall in the locations indicated on the contract documents and provided with an access door.

PART 2 - PRODUCTS

2.01 ABOVEGROUND PIPING SYSTEMS

- A. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings and perform all welding in the shop. Bushings and field welding will not be permitted.

- B. Conceal all piping in areas with suspended and hard ceilings.
- C. All fire protection system pipe and fittings installed outside of the building's thermal envelope shall be hot dipped galvanized.
- D. All fire protection system components, devices, and materials installed as part of this project shall be new.
- E. **All fire protection system components and devices shall be domestically manufactured. Imported components will not be allowed.**

2.02 SPRINKLER PIPE AND FITTINGS

- A. All above-ground wet pipe automatic sprinkler system pipe and fittings shall meet the following criteria:
 - 1. Threaded or Cut Groove: Black and galvanized steel pipe Schedule 40 for sizes less than 8 inches. Black and galvanized steel Schedule 30 for sizes 8 inches and greater. Piping with a lesser schedule value (thinner walled pipe i.e. "Dyna-Thread", XL, Schedule 10, or other Schedule 40 "Replacement" pipe) will not be allowed for threaded or cut groove connections regardless of the corrosion resistance ratio.
 - 2. Roll Groove or Welded: Black and galvanized steel pipe to be either having a minimum wall thickness in accordance with Schedule 10, Schedule 40, U.L. listed, or Factory Mutual Global approved pipe having a U.L. corrosion resistance ratio equal to or greater than 1.0.
 - 3. Grooved Fittings and Couplings: All grooved fittings and couplings shall be manufactured to ASTM A536 requirements for ductile iron castings. The couplings shall consist of two ductile iron housing segments with an elastomer pressure responsive gasket and zinc electroplated bolts and nuts.
 - a. Rigid Style Grooved Couplings: All rigid style couplings shall consist of housings casted with an offset, angle pattern bolt pads to provide rigidity and system support. The coupling installation shall be complete at visual, pad-to-pad offset contact. Rigid couplings that require exact gapping of bolt pads at specified bolt torques are not permitted.
 - b. Flexible Style Grooved Couplings: All flexible style couplings shall consist of housings casted with parallel pattern bolt pads to provide flexibility for vibration attenuation, stress relief, or seismic movement. The coupling installation shall be complete at visual, pad-to-pad contact. Flexible couplings that require exact gapping of bolt pads at specified bolt torques are not permitted.
 - c. Gaskets: All gaskets for wet systems shall be Grade "A" EPDM.
 - d. All grooved couplings and fittings shall be the products of a single manufacturer.
 - e. Grooving tools shall be of the same manufacturer as the grooved components.
 - 4. All fire protection piping and fittings (above-ground) shall be threaded, grooved, flanged, or welded fittings. The use of plain end, lock-type, friction type, compression type, or any other type of fitting that is plain end ("prepared end", "polished end", beveled end, "FIT" end such as Victaulic "FIT", Gruvlok "Sock-It", Victaulic "Pressfit") is not permitted.
 - 5. Welded Outlets and Drilled Outlets for Mechanical Tees: Use outlets for main, branch line, arm-overs, drops, and sprigs only and shall be U.L. listed or Factory Mutual Global approved. Welded outlets with grooved ends shall have a nominal diameter equal to or smaller than the pipe to which they are attached. Welded outlets with threaded ends and

drilled outlets for mechanical tees shall have nominal size outlets at least one pipe diameter smaller than the pipe to which they are attached.

6. Supply Piping From the Flange Above Finished Floor to the Backflow Preventer: Provide cement mortar lined Class 52 ductile iron piping. If acceptable by the Authority Having Jurisdiction, type 304 or 316 stainless steel piping may be installed. All fittings shall be U.L listed or F.M. approved for fire protection installations, shall utilize full flow standard radius fittings, and shall match the type of underground piping to be installed.
7. Approved manufacturers are as follows:
 - a. Black and Galvanized Steel Pipe: Allied Tube and Conduit, AMS Tube Corporation, Bull Moose Tube Company, Charlotte Pipe and Foundry Company, North West Pipe and Casing, State Pipe and Supply Company, Wheatland Tube Company, Youngstown Tube, or prior approved equal.
 - b. Threaded Products: Anvil International, Ward, Youngstown Tube, or prior approved equal.
 - c. Grooved Products: Gruvlok, Tyco (Central), Victaulic, or prior approved equal.
 - d. Factory Segmentally Welded Grooved Products: Fablok (Allied Tube and Conduit), Iowa Fittings, TexLine, Victaulic, or prior approved equal.
 - e. Flanged Products: American Cast Iron Pipe Company, Anvil International, Merit Manufacturing (Mueller), Trinity Valley Iron & Steel Company, Pacific Coast Flange Incorporated, Tyler Pipe, Union Foundry Company, U.S. Pipe and Foundry Company, Ward, or prior approved equal.
 - f. Welded outlets: Anvil International, Island Fitting, Merit Manufacturing (Mueller), NAP (North Alabama Pipe Corporation), Ward, or prior approved equal.
 - g. Ductile Iron Pipe: American Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or prior approved equal.
 - h. Mechanical Joint Products: American Cast Iron Pipe Company, EBBA Iron Incorporated, Pacific States Cast Iron Pipe Company, U.S. Pipe and Foundry Company, or prior approved equal.
 - i. Stainless Steel Fittings: Anvil International, Fablok (Allied Tube and Conduit), Greensboro Pipe Company, Victaulic, or prior approved equal.
 - j. Stainless Steel Pipe: Alaska Copper and Brass, American Pipe and Supply, Greensboro Pipe Company, or prior approved equal.

2.03 SPRINKLER HEADS

- A. Provide minimum nominal ½-inch orifice commercial sprinkler heads with a release mechanism meeting the requirements of N.F.P.A. #13 for thermal sensitivity and temperature rating. Commercial sprinkler heads less than ½-inch orifice will not be allowed unless prior approval is obtained.
- B. Sprinkler body shall be die-cast with the wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation.
- C. Extended coverage sprinkler heads will be allowed, but it will be the Fire Protection Sprinkler System Contractor's responsibility to assure proper implementation.
- D. Extended coverage sprinkler heads will not be allowed in areas requiring sprinkler head guards unless a U.L. listed or Factory Mutual Global approved sprinkler head guard is available.

- E. Provide white finished semi-recessed sprinklers with escutcheons of matching finish in acoustical ceiling tile ceilings.
- F. Provide white finished semi-recessed sprinklers with escutcheons of matching finish in soffits or other gypsum wallboard ceilings that do not contain surface mounted light fixtures.
- G. Provide white finished pendent sprinklers with 2-piece escutcheons of matching finish in rooms that contain entire gypsum wallboard ceilings containing surface mounted light fixtures.
- H. Provide white finished semi-recessed horizontal sidewall sprinklers with escutcheons of matching finish in walls of normally occupied rooms or in rooms that are finished and painted.
- I. Provide chrome finished semi-recessed dry style sprinklers (pendent or sidewall) with escutcheons of matching finish for all installation locations.
- J. Provide bronze uprights in exposed areas (no ceilings) and in ceiling voids.
- K. All quick response sprinkler heads shall be glass bulb style.
- L. All sprinkler heads that utilize "O-Rings" will not be allowed.
- M. Provide corrosion-resistant sprinkler heads (Nickel-Teflon coated or VC-250 coated) in Kitchen Areas, under exterior roofs and overhangs, or as required by N.F.P.A. #13.
- N. The Fire Protection Sprinkler System Contractor shall provide intermediate temperature sprinkler heads for all locations previously required by N.F.P.A. #13 to be of ordinary temperature rating. The 2013 Edition of N.F.P.A. #13 allows intermediate temperature and ordinary temperature sprinkler heads to be installed throughout buildings, thereby reducing the necessity for multiple temperature ratings of sprinkler heads to be installed.
- O. Provide sprinkler head guards on exposed piping installed at an elevation less than 8'-0", or in areas subject to mechanical damage.
- P. All sprinkler head guards shall be specifically listed for the sprinkler head in which they are protecting.
- Q. Approved manufacturers are as follows:
 - 1. Sprinkler Heads: Globe, Reliable, Tyco, Victaulic, Viking, or prior approved equal.
 - 2. Sprinkler Head Guards: Globe, Reliable, Tyco, Victaulic, Viking, or prior approved equal.

2.04 SPARE HEAD CABINET

- A. Provide a metal cabinet for the storage of spare sprinkler heads and head wrenches (adjacent to the sprinkler riser) for each building receiving a fire protection sprinkler system.
- B. The number and types of extra sprinkler heads shall be as specified in N.F.P.A. #13 with one sprinkler wrench being provided for each type of sprinkler head installed.
- C. Spare sprinkler head wrenches shall be provided by the Fire Protection Sprinkler System Contractor that directly engage the wrench boss.
- D. Spare sprinkler head wrenches or other means of removing sprinkler heads (crescent wrenches for example) that are not approved by the sprinkler head manufacturer shall not be provided.

2.05 BACKFLOW PREVENTER

- A. Provide a letter of certification to the Engineer after testing.
- B. The backflow preventer type shall conform to local water purveyor requirements.

- C. The backflow preventer shall be a double check valve assembly style made from cast iron or fabricated steel consisting of (2) independent check valves, (2) OS&Y shut-off valves, and ball type test cocks.
- D. The backflow preventer shall conform to U.L., Factory Mutual Global, FCCC, and HR flow rate with maximum velocity across the backflow preventer of 16 feet per second.
- E. The backflow preventer type and installation configuration shall be listed in the "Backflow Prevention Assemblies Approved for Installation in Washington State" from the Washington State Department of Health.
- F. Approved manufacturers are as follows:
 - 1. Backflow Preventers: Ames, Conbraco, Watts, Wilkins, or prior approved equal.

2.06 FIRE DEPARTMENT CONNECTIONS

- A. Provide a fire department connection approximately 2'-0" to 4'-0" above the finished grade in a location (on the wall) allowed by the authority having jurisdiction.
- B. The fire department connection is to be an approved two-way type with 2½" female National Standard hose thread inlets and a 4" female National Pipe Thread inlet.
- C. Provide the fire department connection with a clapper, cap, and chain for each inlet (double clapper style) and a single identification escutcheon plate.
- D. At the low point near each fire department connection, install a 90-degree drain elbow with a ½" outlet for installation of a ball drip for system drainage to prevent freezing.
- E. Approved manufacturers are as follows:
 - 1. Fire Department Connections: Croker, Elkhart, Guardian, Potter Roemer, Powhattan, or prior approved equal.

2.07 HOSE VALVES FOR FULL FORWARD FLOW TESTING OF THE BACKFLOW PREVENTER

- A. Provide full forward flow testing hose valves approximately 2'-0" to 4'-0" above the finished grade in a location (on the wall).
- B. Provide downstream of the backflow prevention assembly either 2½" angled hose valves or 2½" straight pattern hose valves for full forward flow testing of the backflow preventer.
- C. Provide (1) 2½" hose valve for each 250 g.p.m. of system demand.
- D. Provide a brass valve body with a rising stem, brass internal parts, natural rubber seal, ductile iron hand wheel, 2½" National Pipe Thread by male hose thread outlet.
- E. Provide each hose valve with a cap and chain.
- F. Valve shall be rated for a working pressure of at least 300 p.s.i.
- G. Approved manufacturers are as follows:
 - 1. Hose Valves: Croker, Elkhart, Guardian, Nibco, Potter Roemer, Powhattan, or prior approved equal.

2.08 VALVES

- A. Provide valves of types approved for fire service in accordance with N.F.P.A. #13.
- B. Control valves for fire protection systems shall be either NRS, OS&Y or butterfly style. All butterfly style valves shall be provided with an integral tamper switch and weatherproof actuator.

- C. Provide a valve with an integral tamper switch to piping for sprinkler heads serving elevator pits, elevator mechanical rooms, and sprinklers at the top of elevator shafts. The valve shall be installed at an elevation approximately 5'-0" above finished floor.
- D. Check valves shall be grooved or flanged clear opening spring assisted swing-check type for vertical or horizontal installation of sizes 2½" and larger (butterfly style check valves are not allowed).
- E. Gate valves shall open by counterclockwise rotation.
- F. Provide a normally closed butterfly valve on the piping utilized for full forward flow testing of the backflow preventer. A valve that is normally open in which the wiring of the integral tamper switch is reversed for a normally closed position will not be allowed. The integral tamper switch shall be listed for monitoring of the valve in a closed position such that the slightest opening of the valve will send a signal to the fire alarm system.
- G. Approved manufacturers are as follows:
 - 1. Butterball Valves: Milwaukee, Nibco, Victaulic, or prior approved equal.
 - 2. Butterfly Valves: Anvil International (Gruvlok), McWane (Kennedy), Nibco, Tyco, Victaulic, or prior approved equal.
 - 3. Ball Valves: Anvil International, Milwaukee, Nibco, United Brass, Victaulic, Watts, or prior approved equal.
 - 4. Check Valves: Anvil International (Gruvlok), Reliable, Tyco, United Brass, Victaulic, Viking, or prior approved equal.
 - 5. N.R.S. Gate Valves: McWane (Kennedy), Mueller, Nibco, Victaulic, Wilkins, or prior approved equal.
 - 6. OS&Y Gate Valves: AVK, McWane (Kennedy), Mueller, Nibco, Victaulic, Wilkins, or prior approved equal.

2.09 SHOTGUN RISER ASSEMBLIES

- A. Provide a Shotgun Riser Assembly consisting of a main drain valve, flow switch, pressure gauge, and all accessories for a code compliant fire protection riser.
- B. A shop fabricated piece of pipe containing welded outlets (for the required components) will be acceptable.
- C. Approved manufacturers are as follows:
 - 1. Shotgun Riser Assemblies: Central, Reliable, Tyco, Victaulic, Viking, or prior approved equal.

2.10 LOCAL ALARM DEVICE (ELECTRIC BELL)

- A. Provide a 10" electric alarm bell and back box of the approved weatherproof and guarded type that sounds locally upon the flow of water actuating the paddle of the water flow indicator.
- B. The electric bell shall be tied into the fire alarm system and operate on a 24 volts D.C. power source that is powered through the Fire Alarm Control Panel allowing the electric bell to be on a battery back-up supply.
- C. Mount the alarm bell on the outside of the exterior wall of the building and coordinate with the electrical Contractor the power available for the alarm bell.
- D. Approved manufacturers are as follows:

1. Electric Bells: Potter Electric, System Sensor, or prior approved equal.

2.11 FLOW SWITCH (RISER)

- A. The flow switch shall be vane type with a pipe saddle and cast aluminum housing.
- B. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe.
- C. The flow switch shall sense water movements and be capable of detecting a sustained flow of 10 g.p.m. or greater.
- D. The flow switch shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges and shall be set to actuate the local alarm device in 60 seconds or less.
- E. The flow switch shall contain (2) sets of single pole / double throw (SPDT) Form "C" contacts for the automatic transmittal of an alarm over the facility fire alarm system.
- F. The flow switch shall be tamper resistant and shall be equipped with a silicone rubber gasket to assure a positive water seal and a dustproof cover to seal the flow switch mechanism from dirt and moisture.
- G. Do not install the flow switch within 6" of a fitting that changes direction of the water flow or within 24" of a valve or drain.
- H. The flow switch is to be installed by the Fire Protection Sprinkler System Contractor and wiring of the flow switch is to be performed by the electrical Contractor.
- I. Approved manufacturers are as follows:
 1. Flow Switches: Potter Electric, System Sensor, or prior approved equal.

2.12 TAMPER SWITCHES

- A. Provide tamper switches that are suitable for mounting to the type of control valve to be supervised either in the open or closed position.
- B. The tamper switch shall contain (1) set of single pole / double throw (SPDT) Form "C" contacts arranged to transfer upon opening or closing of the valve of more than two rotations of the valve stem.
- C. Tamper switches shall be tamper resistant and shall be provided for all control valves, backflow preventer valves, post indicating valves, or any other valve used for system shutdown.
- D. Approved manufacturers are as follows:
 1. Tamper Switches: Potter Electric, System Sensor, or prior approved equal.

2.13 INSPECTOR'S TEST CONNECTION

- A. Provide test connections approximately 6 feet above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device.
- B. The Inspector's test connection shall be located at the most remote part of each system.
- C. All inspectors' test connection drain discharges shall be piped down the wall to an elevation approximately 6" above exterior grade before penetrating the exterior wall.
- D. Provide test connection discharge piping to a location where the discharge will be readily visible and where water may be discharged without property damage.

- E. All pipe and fittings outside of the building's thermal envelope shall be hot dipped galvanized and the drain discharge shall terminate with a down turned 45° elbow.
- F. Exterior discharge shall be placed to minimize impacts on landscaping features and coordinated with the General Contractor and Engineer.
- G. Provide a sight glass when the inspectors test discharge cannot be readily visible.
- H. Inspector's test valves installed in finished areas shall be recessed in the wall and provided with a lockable access panel.
- I. The Inspector's test discharge orifice shall be a smooth bore corrosion resistant orifice giving a flow equivalent to one sprinkler of a type having the smallest orifice installed on that system.
- J. If permitted by the authority having jurisdiction the inspector's test valve may be located at the system riser and tied into the main drain discharge.
- K. For inspector's test valves installed at the remote end of the sprinkler system, the inspector's test discharge shall not terminate on the roof or on the roof of a building overhang.
- L. The inspector's test discharge shall be piped down to discharge just above exterior grade level.
- M. The piping shall be located inside a wall or vertical shaft in finished areas.

2.14 COMBINED INSPECTOR'S TEST AND DRAIN ASSEMBLY

- A. The inspector's test connection and the main drain (or auxiliary drain) valve may be combined into a listed unit that performs both functions.
- B. The assembly shall be capable of providing a discharge flow equivalent to one sprinkler of a type having the smallest orifice installed on that system or full flow equivalent to the pipe size serving the assembly.
- C. The assembly shall also contain a sight glass that allows for visual verification of water flow.
- D. The combined inspector's test and drain discharge shall be piped down the wall to an elevation approximately 6" above exterior grade before penetrating the exterior wall.
- E. All pipe and fittings outside of the building's thermal envelope shall be hot dipped galvanized and the drain discharge shall terminate with a down turned 45° elbow.
- F. Exterior discharge shall be placed to minimize impacts on landscaping features and coordinated with the General Contractor and the Engineer.
- G. The combined inspector's test discharge and main drain (or auxiliary drain) valve discharge shall not terminate on the roof or on the roof of a building overhang.
- H. The inspector's test discharge shall be piped down to discharge just above exterior grade level.
- I. The piping shall be located inside a wall or vertical shaft in finished areas.
- J. Approved manufacturers are as follows:
 - 1. Combined Inspector's Test and Drain Assemblies: AGF Manufacturing, GG/J Innovations Inc. (Sure-Test), Victaulic (TestMaster II), or prior approved equal.

2.15 DRAINS

- A. Provide main drain discharge piping to a safe point outside the building.
- B. Provide auxiliary drains for trapped sections of system piping and route all drain discharge piping to a safe point outside the building.

- C. All auxiliary drain valves shall be piped down to an elevation less than 6'-0" above finished floor.
- D. All auxiliary drain discharges shall be piped down the wall to an elevation approximately 6" above exterior grade before penetrating the exterior wall.
- E. Auxiliary drain valves installed in finished areas shall be recessed in the wall and provided with a lockable access panel.
- F. Coordinate all drain locations with the General Contractor and the Engineer.
- G. All pipe and fittings outside of the building's thermal envelope shall be hot dipped galvanized and the drain discharge shall terminate with a down turned 45° elbow.
- H. Exterior discharge shall be placed to minimize impacts on landscaping features and coordinated with the General Contractor and the Engineer.
- I. Termination of main drains or auxiliary drains that allow the discharged water to flow across concrete, asphalt, roof, building overhang roof, gutter, or other finished material will not be allowed.

2.16 ADJUSTABLE DROP NIPPLES

- A. If the Fire Protection Sprinkler System Contractor chooses to, provide adjustable drop nipples that are cold formed from steel tube conforming to ASTM A53 that contain (2) ethylene propylene (EPDM) O-rings for sealing of the independent barrels.
- B. The adjustable drop nipples shall be U.L. listed or Factory Mutual Global approved for installation in accordance with N.F.P.A. #13.
- C. Approved manufacturers are as follows:
 - 1. Adjustable Drop Nipples: Cold Extrusion Company of America (CECA), Merit Manufacturing, or prior approved equal.

2.17 FLEXIBLE PIPING SERVING PENDENT SPRINKLER HEADS

- A. If the Fire Protection Sprinkler System Contractor chooses to, provide flexible pipe assemblies for drops to pendent sprinkler heads that are U.L. listed or Factory Mutual Global approved for use in fire protection sprinkler systems.
- B. The flexible pipe assembly shall utilize 304 stainless steel braided 1" corrugated hose with factory installed adapters (1" MPT for connection to the sprinkler system and ½" or ¾" FPT for connection of the sprinkler head) that are fully welded or use a compression fittings to form a single unit.
- C. The flexible piping unit shall be held securely to acoustical ceiling assemblies by using a mounting bracket that snaps onto the ceiling runners and utilizes self-tapping screws through the center tab of each mounting bracket and the ceiling runner or shall be held securely to acoustical ceiling assemblies by using a tube steel cross member that is secured to the ceiling runner with clips having set screws.
- D. The flexible piping unit shall be held securely to gypsum wallboard ceilings by securing the mounting bracket with four self tapping screws (two on each end) into the metal or wood stud ceiling framing members.
- E. Flexible piping shall be installed to limit the bends from branch lines to the sprinkler heads. Flexible piping drops shall not be installed to form a loop and shall be limited to a change in 3 directions not exceeding an accumulation of 270° (3 @ 90° bends) over the length of the installation.

F. Approved manufacturers are as follows:

1. Flexible Piping Serving Pendent Sprinkler Heads: Easyflex, FlexHead (Flexhead Industries), Vic-Flex (Victaulic), or prior approved equal.

2.18 PIPE HANGERS

- A. Hanger components that attach directly to sprinkler piping or the building structure shall be U.L. listed or Factory Mutual Global approved.
- B. Hangers shall be connected directly to major frame members (Rigid Frames, CMU, Girder Trusses, etc.) wherever possible with connections to secondary framing members (joists, purlins, etc.) being made only when necessary and shall be coordinated with the Structural Engineer.
- C. All C-clamp type hangers shall be fitted with retainer straps.
- D. Hangers consisting of a hanger ring, all thread rods, and a hanger ring attached to a pipe at a higher elevation will not be allowed.
- E. All pipe stands shall be a minimum of 2" or can be sized in accordance with Table 6.3.2.2.1 and Table 6.3.2.2.2 of the 2012 edition of N.F.P.A. #15 for size, height, and spacing.
- F. The only kwik bolt listed and approved for support in cracked concrete is Hilti Kwik Bolt Model KB-TZ, which has passed the ACI 355.2 cracked concrete test. All other kwik bolts will not be allowed.
- G. Approved manufacturers are as follows:
 1. Hangers: Afcon, Anvil International, Erico, Nibco (Tolco), PHD, or prior approved equal.
 2. Attachments: Hilti, ITW Ramset, Simpson Manufacturing Company, Speedy Products (Sammy Super Screw), Textron (HangerMate), or prior approved equal.

2.19 SEISMIC BRACING COMPONENTS

- A. Seismic braces shall be connected directly to major frame members (Rigid Frames, CMU, Girder Trusses, etc.) wherever possible with connections to secondary framing members (joists, purlins, etc.) being made only when necessary and shall be coordinated with the Structural Engineer.
- B. The only kwik bolt listed and approved for seismic bracing in concrete is Hilti Kwik Bolt Model KB-TZ, which has passed the ACI 355.2 cracked concrete test. All other kwik bolts will not be allowed.
- C. Approved manufacturers are as follows:
 1. Seismic Braces: Afcon, Erico, Nibco (Tolco), or prior approved equal.
 2. Attachments: Hilti, ITW Ramset, Simpson Manufacturing Company, or prior approved equal.

2.20 PRESSURE RELIEF VALVES

- A. Each system riser shall be provided with a pressure relief valve not sized less than ½" in size.
- B. The pressure relief valve shall be cast bronze with a rough brass finish.
- C. The pressure relief valve shall be set to operate at a minimum pressure of 175 p.s.i. or 10 p.s.i. in excess of the maximum system pressure, whichever is greater.

- D. In lieu of a pressure relief valve, an auxiliary air reservoir listed for fire protection use that can absorb pressure increases can be provided.
- E. Approved manufacturers are as follows:
 - 1. Pressure Relief Valves: AGF Manufacturing, Watts, or prior approved equal.

2.21 WATER PRESSURE GAUGES

- A. Each system shall have a stainless steel pressure gauge to provide visual supervision of the water pressure.
- B. Provide a minimum 3½" diameter pressure gauge with a ¼" national pipe thread connection.
- C. The pressure gauge shall have an accuracy of 3-2-3% over the range of the gauge per ASME B40.100 (3% over the first ¼ of the gauge range, 2% over the middle ½ of the gauge range, and 3% over the last ¼ of the gauge range).
- D. The pressure gauge shall be calibrated to register up to a maximum of 300 p.s.i. for static water pressures less than 175 p.s.i. and a minimum of 50 p.s.i. above static water pressure when the static water pressure exceeds 175 p.s.i.
- E. Provide a water pressure gauge in the following locations at a minimum.
 - 1. Supply side of the backflow preventer check valves to read the system supply pressure.
 - 2. On the system riser above all check valves or alarm valves to read the system pressure.
- F. Approved manufacturers are as follows:
 - 1. Water Pressure Gauges: Argco, Ashcroft, Moeller Instrument Company Inc., Potter Roemer, Reliable, US Gauge Products, Victaulic, Wika, or prior approved equal.

2.22 AUTOMATIC AIR VENTS

- A. Provide an automatic float type air vent to reduce the amount of trapped air within all wet pipe based automatic fire protection sprinkler systems.
- B. Provide a ball valve in an accessible location between the system piping and the automatic air vent to facilitate maintenance of the automatic air vent.
- C. An automatic air vent shall be installed at the following locations for each sprinkler system installed.
 - 1. Highest point of the system piping.
 - 2. The most remote point of the sprinkler system, unless the most remote point contains an inspector's test valve.
 - 3. On each floor level that the sprinkler system is installed.
- D. The contract documents indicate the conceptual location of where all automatic air vents are anticipated to be installed.
- E. The Fire Protection Sprinkler System Contractor shall determine the exact location of the automatic air vents based upon the piping layout indicated on the Fire Protection Sprinkler System Contractor's shop drawings.
- F. The automatic air vent discharge shall not terminate in the building.
- G. The automatic air vent discharge shall be piped down to discharge just above exterior grade level.

- H. If discharging to the exterior of the building is not practical, the Fire Protection Sprinkler System Contractor shall provide sketches that identify the proposed interior discharge location to the Engineer for approval prior to the Fire Protection Sprinkler System Contractor performing the work.
- I. Approved manufacturers are as follows:
 - 1. Automatic Air Vents: Fire Protection Systems Corrosion Management Inc, Potter Electric, Spirotop, Viking, or prior approved equal.

2.23 ACCESS DOORS

- A. Provide access doors for the following components:
 - 1. Auxiliary drain valves installed in finished areas.
 - 2. Control valves serving sprinklers in elevator pits.
 - 3. Control valves serving sprinklers at the top of elevator hoistways.
 - 4. Control valves serving sprinklers in elevator machine / mechanical rooms.
- B. Access doors shall be installed at an elevation approximately 5'-0" above finished floor.
- C. Access doors in rated walls shall be fire rated with 2" of insulation sandwiched between an inner and outer door panels.
- D. Access doors in non-rated walls are not required to be fire rated.
- E. The access doors shall be cold rolled steel and constructed with a minimum 18 gauge frame and an 18 gauge door panel minimally.
- F. Access doors shall be a minimum of 9" X 9" in size for auxiliary drain valves.
- G. Access doors shall be a minimum of 18" X 18" in size for control valve loops.
- H. Access doors shall mount flush to the finished wall and are not allowed to be surface mounted, unless the wall is CMU or concrete.
- I. Access doors shall be U.L. listed or Factory Mutual Global approved and shall have a continuous hinge, self latching, key operated cylinder lock, and a baked-on primer coating.
- J. All doors shall have an interior latch release mechanism.
- K. Approved manufacturers are as follows:
 - 1. Access Doors: Acudor, Elmdor, Greenheck, JL Industries, Milcor, Nystrom, or prior approved equal.

2.24 WALL PLATES

- A. Provide a split hinge type metal plate for piping passing through walls, floors, platforms, and ceilings installed in exposed spaces.
- B. Wall plates shall either be chrome plated or factory painted to match the surrounding color scheme.

2.25 OVERSIZED ESCUTCHEON TRIM RINGS

- A. The Fire Protection Sprinkler System Contractor shall provide oversized escutcheon trim rings to conceal the ceiling system penetrations that are oversized to meet the requirements of the International Building Code (I.B.C.) and ASCE 7.

- B. The Fire Protection Sprinkler System Contractor shall verify with the local Authority Having Jurisdiction that oversized penetrations and escutcheon trim rings for existing ceiling system penetrations to meet the International Building Code (I.B.C.) and ASCE 7 will not be required.
- C. The oversized escutcheon trim rings shall be the same finish as the sprinkler head and escutcheon in which it is to be installed.
- D. The oversized escutcheon trim rings shall be made of cold rolled steel.
- E. To maintain the fire ratings, plastic or other materials that will not maintain a rating will not be allowed.
- F. Approved manufacturers are as follows:
 - 1. Oversized Escutcheon Trim Rings: Fire Lock (Victaulic), Reliable, or prior approved equal.

2.26 LIST OF SPRINKLERS

- A. The Fire Protection Sprinkler System Contractor shall provide a typed list of all sprinkler heads installed in the project per the requirements of N.F.P.A. #13.
- B. The typed list shall be placed within the spare sprinkler cabinet and shall identify each sprinkler by Sprinkler Identification number, manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure rating.
- C. The typed list shall also provide a general description, the quantity of each type of sprinkler provided within the spare head cabinet, and the date the list was generated.

2.27 IDENTIFICATION SIGNS

- A. Provide a permanently marked metal or engraved rigid plastic identification sign with proper lettering and secured with corrosion resistant wire, chain, or other approved methods for all control valves, drain valves, inspector's test valves, and fire department connection zones in accordance with N.F.P.A. #13.

2.28 HYDRAULIC SIGNS (PLACARDS)

- A. Each sprinkler system riser shall have the N.F.P.A. #13 required hydraulic sign placed near the control valve that is permanently marked and made either of weatherproof metal, rigid plastic or weatherproof tyvek.
- B. The hydraulic sign shall be permanently secured with corrosion resistant wire, chain, or adhesive backing.
- C. The hydraulic sign shall identify the location of the design area, discharge density, design area size, system demands at the base of riser, hose stream allowances, current water flow information, auxiliary design parameters (densities and areas) associated with the system installed, and the name of the installing Fire Protection Sprinkler System Contractor.

2.29 GENERAL INFORMATION SIGNS (PLACARDS)

- A. Each sprinkler system riser shall have the N.F.P.A. #13 required general information sign placed near the control valve that is permanently marked and made either of weatherproof metal, rigid plastic or weatherproof tyvek.
- B. The general information sign shall be permanently secured with corrosion resistant wire, chain, or adhesive backing.
- C. The general information sign shall identify the name and location of the facility protected, the presence of high piled and/or rack storage, maximum height of storage planned, aisle width planned, commodity classification, encapsulation of pallet loads, presence of solid shelving,

flow test data, presence of flammable/combustible liquids, presence of hazardous materials, presence of other special storage, location of all auxiliary drains and low pint drains, original results of main drain flow test, name of installing Fire Protection Sprinkler System Contractor or designer, and the indication of presence or location of anti-freeze or other auxiliary systems.

2.30 FULL FORWARD FLOW TEST SIGNS (PLACARDS)

- A. The Fire Protection Sprinkler System Contractor shall provide a sign that is to be attached to the backflow preventer that is permanently marked and made either of weatherproof metal, rigid plastic or weatherproof tyvek.
- B. The full forward flow test sign shall be permanently secured with corrosion resistant wire, chain, or adhesive backing.
- C. The full forward flow test sign shall indicate the following information:
 - 1. Pressure on the supply side of the backflow preventer assembly prior to testing.
 - 2. Pressure on the discharge side of the backflow preventer assembly prior to testing.
 - 3. Pressure on the supply side of the backflow preventer assembly during testing.
 - 4. Pressure on the discharge side of the backflow preventer assembly during testing.
 - 5. Total pressure drop across the backflow preventer assembly during testing.
 - 6. System test flow rate based upon hydraulic system demands.
 - 7. Manufacturer's documented pressure drop data from the pressure drop flow curve.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with N.F.P.A. #13, except as modified herein.
- B. All piping and fittings installed prior to the backflow preventer are considered part of the potable water system and shall be required to be of a type that maintains a clean and rust free potable system. The use of black and galvanized pipe and fittings on the potable waterside of the backflow preventer will not be allowed.
- C. Grooved couplings and fittings shall be installed in accordance with the manufacturer's recommendations. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove. Grooved coupling gaskets shall be molded and produced by the coupling manufacturer.
- D. The Fire Protection Sprinkler System Contractor shall remove and replace any piping joints deemed improperly installed or show signs of leakage.
- E. The Fire Protection Sprinkler System Contractor shall remove and replace any piping that has been damaged upon installation and shows signs of being bent, warped, or dented.
- F. Do not install sprinklers heads that have been dropped, damaged, show signs of corrosion, show signs of foreign matter buildup, show signs of a cracked glass bulb, or show a visible loss of fluid.
- G. The glass bulb protector shall remain in place until the sprinkler head is completely installed. The Fire Protection Sprinkler System Contractor shall remove the glass bulb protector by hand after installation and prior to the sprinkler system being placed in service.

- H. Install piping straight and true to bear evenly on hangers and supports. Hangers for piping to attach to structural members with no hanger being attached to acoustical ceiling tiles or gypsum wallboard ceilings.
- I. All sprinkler heads installed to protect the area under ductwork or similar obstructions shall be restrained from lateral movement.
- J. Ends of new piping and existing piping affected by the Fire Protection Sprinkler System Contractor's operations shall be thoroughly cleaned of water, cutting oil, and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods and securely close open ends of piping when work is not in progress to prevent entry of foreign matter. Inspect all piping before placing into position for foreign matter and remove as necessary.
- K. All piping in finished areas shall be installed concealed above the ceiling space unless specifically noted otherwise.
- L. Any portion of the sprinkler system that is not indicated on the contract documents to be installed exposed shall be addressed in writing with sketches (prior to the piping being fabricated or installed) to the Engineer to evaluate.
- M. Install piping at such heights and in such a manner so as not to obstruct any portion of windows, doorways, passageways, or lights. Coordinate installation of piping with all trades (mechanical, electrical, plumbing, and structural) to avoid conflicts and offset piping as required to clear any interferences that may occur.

3.02 CEILING SYSTEM PENETRATIONS

- A. All pendent sprinkler heads installed in ceiling systems shall meet the requirements of the International Building Code (I.B.C.) and ASCE 7 by one of the following options:
 - 1. Oversized ceiling system penetrations shall be required on all hard piped pendent sprinkler heads installed in ceiling systems. The oversized ceiling system penetration shall have a 1" annular space around the ceiling penetration that will allow free movement of at least 1" in all directions.
 - 2. Tight ceiling system penetrations shall be allowed when a swing joint is installed at the top of the sprinkler head drop that can accommodate 1" of ceiling movement in all directions.
 - 3. Tight ceiling system penetrations shall be allowed when a flexible sprinkler drop is installed that can accommodate 1" of ceiling movement in all directions.
 - 4. Tight ceiling system penetrations shall be allowed when the sprinkler system and ceiling system are tied together as an integral unit and evaluated by a registered design professional hired by the Fire Protection Sprinkler System Contractor.

3.03 RESTRAINT OF SPRINKLER SYSTEM BRANCH LINES

- A. Sprinkler system branch lines shall be laterally restrained at intervals not exceeding those specified in Table 9.3.6.4(a) of the 2013 Edition of N.F.P.A. #13 and are based upon the branch line diameter and the seismic coefficient value of C_p .
 - 1. Table 9.3.6.4(a) of the 2013 Edition of N.F.P.A. #13.

Steel Piping Pipe Diameter (in)	Seismic Coefficient (C_p)		
	$C_p \leq 0.50$	$0.5 < C_p \leq 0.71$	$C_p > 0.71$
1	43	36	26
1¼	46	39	27

1½	49	41	29
2	53	45	31

- B. Means of providing branch line restraint shall comply with one of the means contained within Section 9.3.6.1 of the 2013 Edition of N.F.P.A. #13.
1. A listed sway brace assembly.
 2. A wraparound U-hook satisfying the requirements of Section 9.3.5.5.11.
 3. Number (12) 440 pound wire installed at least 45° from the vertical plane and anchored on both sides of the pipe.
 4. Other prior approved means by the Engineer.
 5. An additional hanger is required where all of the following criteria are met:
 - a. Is installed not less than 45° from vertical.
 - b. Is installed within 6" of the vertical hanger.
 - c. Is arranged for restraint against vertical upward movement.
 - d. The L/R ratio does not exceed 400.
 - e. The rods extend down to the pipe or has a surge clip installed.

3.04 RESTRAINT OF SPRINKLER DROPS

- A. All sprinkler system drops shall be restrained against excessive movement per the following minimum criteria listed below.
- B. Pendent sprinkler heads or drops to pendent sprinkler heads that move more than 3" from the stagnant position (from a light push) after installation of the system or allows the pendent sprinkler head or drops to pendent sprinkler heads to oscillate without dampening to the stagnant position (in a reasonable amount of time) shall be provided with additional restraint.
- C. Means of providing restraint to drops shall comply with one of the means contained within Section 9.3.6.1 of the 2013 Edition of N.F.P.A. #13.
1. A listed sway brace assembly.
 2. A wraparound U-hook satisfying the requirements of Section 9.3.5.5.11.
 3. Number (12) 440 pound wire installed at least 45° from the vertical plane and anchored on both sides of the pipe.
 4. Other prior approved means by the engineer.
 5. An additional hanger is required where all of the following criteria are met:
 - a. Is installed not less than 45° from vertical.
 - b. Is installed within 6" of the vertical hanger.
 - c. Is arranged for restraint against vertical upward movement.
 - d. The L/R ratio does not exceed 400.
 - e. The rods extend down to the pipe or have a surge clip installed.
- D. When flexible piping assemblies are installed, the piping drops will be allowed to have more movement. The movement of the piping drops shall be less than the amount allowed by the flexible piping assembly. When the piping drops have sufficient movement to cause the flexible

piping to pull on the installed sprinkler head, additional restraint shall be provided, as detailed in the section above.

3.05 SPRINKLER PROTECTION OF EXTERIOR OVERHANGS AND CANOPIES

- A. Provide sprinkler protection beneath all exterior overhangs and canopies that exceed 4'-0" in depth in which any member that comprises the exterior overhang and canopy is of combustible construction (entire canopy construction, not just exposed surface).
- B. Provide sprinkler protection beneath all exterior overhangs and canopies that exceed 2'-0" in depth, where the area underneath the exterior overhang and canopy is used for the storage or handling of combustibles regardless of the construction type.
- C. Provide sprinkler protection inside all exterior overhangs and canopies comprised of combustible construction and the clear space between framing members exceeds 6" in height.
- D. Provide sprinkler protection inside and beneath all exterior overhangs and canopies required by the local Authority Having Jurisdiction and as indicated on the contract documents.

3.06 PURITY TESTING OF PIPING INSTALLED BEFORE BACKFLOW PREVENTION DEVICE

- A. Disinfect the new potable water piping affected by the Fire Protection Sprinkler System Contractor's operations in accordance with the health authority, water purveyor having jurisdiction, AWWA C651, and AWWA C652.
- B. Exercise caution when mixing chlorine disinfectant solutions.
- C. Fill piping systems or piping affected by the Fire Protection Sprinkler System Contractor's operations with solution containing a minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours or use a solution containing a minimum of 200 parts per million of chlorine and allow solution to stand for minimum of 3 hours.
- D. Following the required standing time, the piping shall be flushed with clean potable water until the maximum residual chlorine content is not greater than that of the domestic water supply or 0.2 part per million.
- E. Have a certified laboratory analyze the results from two consecutive satisfactory bacteriological samples and submit these results before the piping is placed into service.
- F. Purity testing of piping supplied by non-potable water sources will not be required.

3.07 PREPARATION OF SPRINKLER PIPING FOR PAINTING IN EXPOSED AREAS

- A. The Fire Protection Sprinkler System Contractor shall clean the exterior surface to the sprinkler piping that is to be painted. The piping shall be cleaned and prepped in the following manner.
 - 1. The Fire Protection Sprinkler System Contractor shall remove all pipe tags or fabrication labels that have been adhered to the sprinkler system piping as part of the listing/fabrication process.
 - 2. Any adhesive that remains on the sprinkler piping after removal of the pipe tags or fabrication labels shall be removed with an acceptable adhesive solvent.
 - 3. All sprinkler piping and fittings that show signs of surface rust shall be sanded to remove the rust from the sprinkler piping.
 - 4. Sprinkler system piping shall be wiped down with a solvent soaked rag to remove cutting oil residue, finger prints, adhesive solvents, and other foreign materials that could prevent the primer and/or finished color coats of paint from adhering properly to the sprinkler system piping.

3.08 PROTECTION OF SPRINKLER HEADS DURING PAINTING OR SPRAY APPLICATIONS

- A. The Fire Protection Sprinkler System Contractor shall provide and install a suitable means of protecting the sprinkler heads against the accumulation of foreign matter build up during the time that the exposed structure is either being painted, having fire proofing applied, or during other applications that put particulates into the air that potentially could collect upon the sprinkler heads.
- B. At the conclusion of the processes listed above, the Fire Protection Sprinkler System Contractor shall be responsible for removing the protective coverings, visually inspecting the sprinkler heads for foreign matter build-up, and shall replace all sprinkler heads where build-up of foreign matter is observed at no additional cost to the Port.

3.09 HYDROSTATIC TEST

- A. Hydrostatically test each system at 200 P.S.I. or 50 P.S.I. in excess of the systems working pressure (whichever is greater), for a 2-hour period with no leakage or reduction in pressure.
- B. Piping above ceilings shall be tested, inspected, and approved before installation of ceiling material.
- C. When tests have been completed and corrections made, submit a signed and dated certificate similar to that specified in N.F.P.A. #13.

3.10 WATER FLOW TEST

- A. Test the alarms and other devices by flowing water through the inspector's test connection.
- B. Upon activation of the inspector's test valve, the time to sound the local alarm device shall not be greater than 60 seconds.
- C. When tests have been completed and corrections made, submit a signed and dated certificate similar to that specified in N.F.P.A. #13.

3.11 FLUSHING OF PIPE

- A. Flush piping with potable water in accordance with N.F.P.A. #13 at a minimum velocity of 10 feet per second.
- B. Flow for Class 52 Ductile Iron piping shall be at least 290 g.p.m. for 3-inch pipe, 440 g.p.m. for 4-inch pipe, 970 g.p.m. for 6-inch pipe, 1,725 g.p.m. for 8-inch pipe, 2,650 g.p.m. for 10-inch pipe, and 3,800 g.p.m. for 12-inch pipe.
- C. Flow for Type 304 or Type 316 Stainless Steel piping shall be at least 235 g.p.m. for 3-inch pipe, 400 g.p.m. for 4-inch pipe, 905 g.p.m. for 6-inch pipe, 1,560 g.p.m. for 8-inch pipe, 2,460 g.p.m. for 10-inch pipe, and 3,535 g.p.m. for 12-inch pipe.
- D. Flow for Type K copper piping shall be at least 210 g.p.m. for 3-inch pipe, 365 g.p.m. for 4-inch pipe, 810 g.p.m. for 6-inch pipe, 1,410 g.p.m. for 8-inch pipe, 2,190 g.p.m. for 10-inch pipe, and 3,135 g.p.m. for 12-inch pipe.
- E. Continue flow for a sufficient time to ensure thorough cleaning.

3.12 FULL FORWARD FLOW TESTING OF THE BACKFLOW PREVENTER

- A. The backflow preventer assembly shall be tested at system flow demand, including all applicable inside hose stream allowances.
- B. The Fire Protection Sprinkler System Contractor shall provide all equipment and instruments necessary to conduct a complete full forward flow test of the backflow assembly including 2½"

hoses for each angled hose valve installed, calibrated pressure gauges, playpipe nozzles, and pitot tube gauge.

3.13 FORMAL TESTS AND INSPECTIONS

- A. Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved.
- B. Submit a written request to local fire protection authority for formal inspection at least 15 days before the inspection date.
- C. An experienced technician regularly employed by the system installer shall be present during the inspection.
- D. At this inspection, repeat any or all of the required tests as directed.
- E. Correct defects in work provided by the Fire Protection Sprinkler System Contractor and make additional tests until the system(s) comply with contract requirements.
- F. Furnish appliances, equipment, electricity, instruments, connecting devices and personnel for the tests.
- G. The Port will furnish water for the tests.
- H. Furnish Engineer with three (3) copies of certificates required by testing agencies.

3.14 TRAINING PERIOD

- A. Upon completion of the work and after all tests and inspections by the authority(s) having jurisdiction, the Fire Protection Sprinkler System Contractor shall demonstrate and train the Port's designated operation and maintenance personnel in the operation and maintenance of the fire protection system.
- B. The Fire Protection Sprinkler System Contractor shall arrange scheduled instruction periods with the Port's designated operation and maintenance personnel.
- C. The Fire Protection Sprinkler System Contractor's representatives shall be superintendents or foremen who are knowledgeable in each system and suppliers representatives when so specified.
- D. Scheduled training periods shall be based upon complexity of the system installed, but in no case be less than indicated in Paragraph 3.03 of Specification Section 21 00 00.01.
- E. Upon request of the Port, a DVD of the training period shall be made available by the Fire Protection Sprinkler System Contractor at no additional cost to the Port.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 07 19.01 – “Piping Insulations”
 - 3. Section 22 11 19.01 – “Piping Specialties”

1.02 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.0 for building service piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve material for potable-water service.

1.03 SUMMARY

- A. Section Includes:
 - 1. Gate valves
 - 2. Globe Valves
 - 3. Ball valves
 - 4. Check valves
 - 5. Balancing valves

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

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

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Valve Diagram

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure rating indicated; provide proper selection as determined by installer to comply with installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option. Valves shall be of same make for all these services.

2.02 GATE VALVES

- A. Packing - Select valves, equipped with packing suitable for intended service. (Under no circumstances is asbestos acceptable.) Select valves designed so back seating protects

packing and stem threads from media when valve is fully opened, and equipped with gland follower. Guides for disc on rising stem valves must be machined for accurate fit.

B. Comply with the following standards:

1. Bronze Valves: MSS SP – 80

C. Valves:

1. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed bonnet, rising stem, solid wedge, lead free. (Non-rising stem gate valves may be used where headroom prevents full extension of rising stems).
2. Solder Ends 2" and Smaller: Class 125, bronze body, screwed bonnet, rising stem, solid wedge, lead free. (Non-rising stem gate valves may be used where headroom prevents full extension of rising stems).
3. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge, lead free.

D. Manufacturer: Subject to compliance with requirements, provide gate valves of one of the following:

1. Nibco
2. Milwaukee Valve Company
3. Stockham

2.03 GLOBE VALVES

A. Packing - Select valves, equipped with packing suitable for intended service. (Under no circumstances is asbestos acceptable.) Select valves designed so back seating protects packing and stem threads from media when valve is fully opened, and equipped with gland follower.

B. Composition Discs - Where required, provide suitable material for intended service.

C. Comply with the following standards:

1. Bronze Valves: MSS SP - 80

D. Valves:

1. Threaded Ends 2" and Smaller: Class 125, bronze body, union bonnet, rising stem, Teflon disc, lead free.
2. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed bonnet, rising stem, bronze disc (swivel type), lead free.
3. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bolted bonnet, rising stem, OS&Y, renewable seat and discs.

E. Manufacturers: Subject to compliance with requirements, provide globe valves of one of the following:

1. Nibco
2. Milwaukee Valve Company
3. Stockham

2.04 BALL VALVES

- A. General - Select with **FULL** port opening blow-out proof stem, rated not less than 600# W.O.G.
- B. Comply with the following standards:
 - 1. MSS SP-110 Ball Valves - THREADED, SOLDER JOINT
- C. Valves:
 - 1. Threaded Ends 2" and Smaller: 600# W.O.G., bronze two piece body, full port hard chrome plated bronze ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem, lead free.
 - 2. Soldered Ends 2" and Smaller: 600# W.O.G., bronze two piece body, full port hard chrome plated bronze ball, true adjustable packing nut ("O"-ring only type stem seal not acceptable), blow-out proof stem, lead free.
- D. Manufacturers: Subject to compliance with requirements, provide ball valves of one of the following:
 - 1. Nibco
 - 2. Milwaukee Valve Company
 - 3. Apollo (By Conbraco Industries)

2.05 SWING CHECK VALVES

- A. General - Construct pressure containing parts of Valves as follows:
 - 1. Bronze Valves, 125 or 150 psi: ANSI/ASTM B 62
 - 2. Iron Body Valves: ANSI/ASTM A-126, Grade B
- B. Comply with the following standards for design, workmanship, material and testing:
 - 1. Bronze Valves: MSS SP-80
 - 2. Cast Iron Valves: MSS SP-71
- C. Construct valves of pressure castings free of any impregnating materials.
- D. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
 - 1. Valves:
 - a. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, PTFE Seat Disc, lead free.
 - b. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, PTFE Seat Disc, lead free.
 - c. Flanged Ends 2-1/2" and Larger: Class 125, cast iron body, bronze mounted, horizontal swing, bronze disc, lead free.
 - d. Manufacturer: Subject to compliance with requirements, provide Swing Check valves of one of the following:
 - 1) Nibco Valve
 - 2) Milwaukee Valve Company
 - 3) Stockham Valve

2.06 BALANCING VALVES

- A. Valves shall have low lead content in conformance with the reductions of lead in Drinking Water Act.
- B. Each valve shall have two 1/4" NPT brass metering ports with Nordel check valves and gasketed caps located on both sides of valve seat. Two additional 1/4" NPT connections with brass plugs are to be provided on the opposite side of the metering ports for use as drain connections. Drain connections and metering ports are to be interchangeable to allow for measurement flexibility when valves are installed in tight locations.
- C. Valves are to be of the "Y" pattern, modified, equal percentage globe style and provides three functions:
 - 1. Precise flow measurement
 - 2. Precision flow balancing
 - 3. Positive drip tight shut off
- D. Valves shall provide multi-turn, 360° adjustable with a micrometer type indicator located on valve handwheel. Valve handwheel shall have a memory feature, which will provide a means for locking the valve position after the system is balanced. 90° turn adjustable valves are not acceptable.
- E. Valve Sizes 1/2" – 2": Valve body shall be bronze with ultra-high strength engineered resin or stainless steel plug. The plug shall have precision-contoured channels to distribute flow uniformly across valve seat. Low-lead brass stem and high strength resin handwheel and sleeve. Valves shall have a minimum of four full 360° handwheel turns.
- F. Single Turn Mini Sweat Size (1/2" to 3/4"):
 - 1. Valve shall be globe style design with bronze body, solder end connection, bronze trim with EPDM plug, high strength resin handwheel with valve position locking inserts, and two 1/4" NPT brass metering ports with Nordel check valves and gasketed caps located on both sides of the valve seat.
 - 2. Valve shall be providing three functions:
 - a. Precision flow measurement
 - b. Precision flow balancing
 - c. Positive drip tight shut-off
 - 3. Valve shall provide 360° single turn adjustment range with indicating scale on valve handwheel.
 - 4. The valve shall be installed with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump, with two pipe diameters downstream from the valve should be free of any fittings. When installed easy unobstructed access to the valve handwheel and metering ports for adjustment and measurements shall be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.
- G. Insulation (1/2" to 2"):
 - 1. Each valve shall be furnished with a pre-formed removable PVC insulation jacket to meet ASTM D 1784/class 14253-C, MEA#7-87, ASTM-E-84 and ASTM-136 with a flame spread rating of 50 or less. There will be provided sufficient mineral fiberglass insulation to meet

ASHRAE 90.1-1989 specifications in operating conditions with maximum Fluid Design Operating Temperature Range of 141-200°F and Mean Rating Temperature of 125°F.

H. Approved Manufacturers:

1. Red-White Valve

2.07 BACKFLOW PREVENTION DEVICES

A. See Section 22 11 19.01.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Except as otherwise indicated, comply with the following requirements.
- B. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- C. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward for horizontal plane unless unavoidable.
 1. Applications Subject to Shock: Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
 2. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:
 - a. Tube Size 2" and Smaller: Soldered-joint valves.
 - b. Pipe Size 2" and Smaller: One of the following at installer's option:
 - 1) Threaded Valves
 - 2) Grooved-end Valves
 - c. Pipe Size 2-1/2" and Larger: One of the following at installer's option:
 - 1) Threaded end Valves
 - 2) Butt-weld end Valves
 - 3) Flanged end Valves
 - 4) Wafer Type Valves
 - 5) Mechanical joint end Valves
 - 6) Grooved end Valves

3.02 INSTALLATION OF CHECK VALVES

- A. Swing Check Valves: Install in horizontal position, unless otherwise shown on drawings, with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.

3.03 VALVE DIAGRAM

- A. Provide (2) Valve Diagrams showing the location of all valves relative to the floor plan of the building. Each Valve Diagram shall be 11x17, hard laminated sheets. Each piping system shall be in a unique color and a legend noting the system colors shall be placed on the first page. Provide a non-laminated copy for the O&M Manual.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 07 19.01 – “Piping Insulations”
 - 3. Section 22 11 19.01 – “Piping Specialties”
 - 4. Section 22 20 00.01 – “Excavation and Backfill for Mechanical Underground Utilities”
 - 5. Section 23 05 48.01 – “Vibration and Seismic Control”

1.02 GENERAL

- A. Includes:
 - 1. Pipe Hangers and Supports
 - 2. Mechanical Equipment Anchors and Supports

1.03 QUALITY ASSURANCE

- A. Pipe Hanger Standards: (MSS) Manufacturers Standardization Society Standards SP-58-2002, SP-89-2003, and SP-69-2003.
- B. All methods, materials, and workmanship shall conform to the International Building Code (IBC) and International Mechanical Code (IMC), as amended and adopted by the authority having jurisdiction.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Hangers.
- B. Struts.
- C. Anchors.
- D. Shop drawings are required for all equipment supports and fabricated supports or assemblies.

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not applicable

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Hangers and Supports: Elcen, Grinnell, B-Line Systems, Unistrut, Michigan, Tolco, PHD.
- B. Anchors: Rawplug, Phillips, Hilti, Michigan.

2.02 GENERAL HANGERS AND SUPPORTS

- A. Hanger Rods: Threaded hot rolled steel, electro-galvanized or cadmium plated. Hanger rods shall be sized so that the total load (including pipe or duct, insulation, hangers, and fluid) does not exceed the following:

<u>Nominal Rod Diameter</u>	<u>Maximum Load</u>
3/8 Inch	610 Pounds

1/2 Inch 1130 Pounds

- B. Hanger Straps: Galvanized steel. Straps shall be sized so that the total load does not exceed the following:

<u>Strap Size</u>	<u>Maximum Load</u>
1" x 22 Gauge	230 Pounds
1" x 20 Gauge	290 Pounds
1" x 18 Gauge	380 Pounds
1" x 16 Gauge	630 Pounds

- C. Beam Attachments: Shall be of the following type:

<u>MSS Type</u>	<u>Elcen Figure No.</u>	<u>Grinnel Figure No.</u>
21	33, 34	131
22	67	66
23	29A	87
28	95	292, 228
30	95	229

- D. Anchors: Masonry anchors shall be Phillips wedge anchors, Phillips "Red Head" or Rawl "Saber-Tooth".
- E. Steel: Structural steel per ASTM A36.
- F. Wood: Shall be fire treated.

2.03 PIPE HANGERS AND SUPPORTS

- A. All hangers used directly on copper pipe shall be copper plated or have a factory applied 1/16-inch thick (minimum) plastic coating on all contact surfaces.
- B. All other hangers, supports, and hardware shall be cadmium plated or galvanized.
- C. Fire sprinkler supports shall comply with NFPA-13.
- D. Pipe Hangers and Supports: Shall be of the following type (numbers are 'MSS'):

<u>Maximum System Temperature</u>	<u>Insulated Pipe Type</u>
120 to 450 Degrees	1, 3, 7, 9, 10, 41, 42, 43, 44, 45, 46, E
60 to 120 Degrees	1, 3, 7, 9, 10
33 to 59 Degrees	1, 3, 5, 7, 9, 10, 41, 42, 43, 44, 45, 46, E

- E. Vertical Pipe Supports: MSS Type 8 riser clamp (Elcen Fig. 39 and 339; Grinnel Fig. 261 and 261C).
- F. Trapeze Hangers: Shall be constructed of carbon steel angles, channels, or other structural shapes with flat surface for point of support. Trapeze hangers shall be supported with hanger rods suspended from concrete inserts or approved structural clips. Provide a steel washer plate (Elcen Fig. 84 or equal) where hanger rod nuts bear on trapeze hanger.
- G. Insulated Pipe Supports and Insulation Shields:

1. Insulation material at pipe support shall consist of expanded perlite insert with flame resistant jacket of nylon reinforced kraft paper bonded to aluminum foil cover on insulation, with sheet metal shield. Expanded perlite shall have no more than 5% deformation at 100 psi and a thermal conductivity no more than 0.32 Btu/hr./sq. ft./degree F/1-inch thick.
2. Expanded perlite insert shall be same thickness as adjoining pipe insulation and sized to match pipe in which it is used on. See Section 22 07 19.01 for insulation sizes.
3. Provide shield per Section 22 11 19.01 Piping Specialties.
4. Manufacturer: Michigan Hanger Company, Model Nos. 1031 and 4031.

PART 3 - EXECUTION**3.01 INSTALLATION - GENERAL**

- A. Provide all necessary bolts, nuts, washers, turnbuckles, rod connectors, and any other miscellaneous accessories required for the support and anchoring of all pipes, ducts, and mechanical equipment.
- B. Install steel or wood backing in walls (anchored to studs) as required to provide support for items hung from walls.
- C. Install concrete inserts and anchors in accordance with manufacturer's instructions.
- D. All welded steel support assemblies shall have a power wire brush and primer paint finish.
- E. Maximum spans between piping supports may be significantly less than the maximum spans allowed herein due to structural limitations of allowable loads on hangers. The most restrictive criteria governs. Reference structural drawings.

3.02 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- A. Pipe which is not run underground, shall be adequately anchored to the structure to prevent sagging and to keep pipe in alignment.
- B. All pipe supports shall be provided with a means of adjustment for the aligning and leveling of the pipe after installation.
- C. Installation and sizing of pipe supports and accessories shall be in accordance with the manufacturer's recommendations and standard MSS SP-89 and MSS SP-69, NFPA #13 for fire protection piping, UPC, and IMC.
- D. Provide supports at each change in direction of piping; and on cast iron soil pipe at each branch connection and at each side of concentrated loads.
- E. Where mechanically coupled piping is used, a hanger shall be placed within 2 feet on each side of couplings, with hanger spacing in no case to exceed the following:

Nominal Pipe Diameter	Maximum Span Mechanically Coupled Piping
3/4 to 1 Inch	7 Feet
1 ¼ to 1 ½ Inch	7 Feet
2 Inches	10 Feet

NOTE: Manufacturer's support instructions shall be used where it is more restrictive than the above. Above is for rigid coupled piping systems. Follow manufacturer's requirements for flexible piping systems, except that in no case are spacing to be more than the above.

- F. Steel Pipe: Maximum spacing between supports:

Nominal Pipe Diameter	Maximum Span Steel Pipe
------------------------------	--------------------------------

1/2 Inch	6 Feet
3/4 to 1 Inch	8 Feet
1 ¼ to 2 ½ Inch	10 Feet

- G. Copper Tubing: Maximum spacing between supports:

Nominal Tubing Diameter	Maximum Span Copper
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1/2 Inch	5 Feet
3/4 to 1 ¼ Inch	6 Feet
1 ½ to 2 ½ Inch	8 Feet

- H. Cast Iron Soil Pipe: Maximum spacing between supports shall be 5 feet, except when the pipe length between joints exceeds 5 feet, in which case the maximum spacing between supports may be 10 feet.
- I. No-Hub Cast Iron Soil Pipe: Shall be supported at every other joint, except when the pipe length between joints exceeds 4 feet, in which case the pipe shall be supported at each joint. Supports shall be provided at each horizontal branch connection and shall be adjacent to couplings.
- J. Three or more pipes running parallel may be supported on trapeze hangers provided the slopes of such pipes allow use of common trapeze. Where trapeze width exceeds 24 inches, provide three (3) hanger rod supports.
- K. Provide additional supports at concentrated loads (such as valves, in-line pumps, etc.) on each side of the load. Such supports are in addition to the ones otherwise required.
- L. Vertical Piping Supports: Support piping at each floor line with pipe clamps and at intermediate points as required to prevent excessive pipe movement and so as to comply with the maximum spacings cited above. Support all pipe stacks at their bases with a concrete pier or suitable hanger. For vertical pipe drops which occur away from a wall or similar anchoring surface, provide angled bracing from nearest structure to provide rigid anchoring of pipe drop.
- M. Insulated Pipe Supports and Insulation Shields: Protect insulated pipe at point of support with pipe insert and shield as required by the following table:

NOMINAL PIPE DIAMETER IN INCHES	INSULATION LENGTH IN INCHES	SHIELD LENGTH IN INCHES	MINIMUM SHIELD GAUGE
½ to 2	6	6	20
2 ½ to 3 ½	6	6	18
4 to 5	9	8	18

Such supports shall be in place at the time of installing pipe.

- N. Underground Pipe: Shall be evenly supported on approved bedding materials, as specified for the type of piping being used. Such bedding and backfilling shall be as specified in Section 22 20 00.01.

3.03 INSTALLATION OF MECHANICAL EQUIPMENT ANCHORS AND SUPPORTS

- A. Provide anchoring and supports for all mechanical equipment.
- B. Roof mounted equipment shall be installed on roof curbs provided with the equipment (unless indicated otherwise). Such equipment shall be anchored to the curb, with the curb anchored to the building structure.
- C. Equipment shall be supported and anchored in such a way so that no equipment vibration is transmitted to the building structure.
- D. Added supports and bracing shall be provided per Section 22 05 48.01.
- E. Provide curbing as shown on drawings and as required to support all mechanical equipment.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 20 00 00.01 – “General Mechanical Requirements”

1.02 SUBMITTAL REQUIREMENTS

- A. Submittal Requirements of this Section

- 1. Isolation pads
 - 2. Spring isolators

1.03 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURES

- A. Not Applicable

2.02 NEOPRENE ISOLATORS

- A. Isolation Pads: Oil resistant neoprene pads, minimum ¼-inch thick, with cross-ribbed or waffle design. Size pads for not more than 50 psi or as recommended by vibration isolator manufacturer.
- B. Floor Mounted Isolators: Double deflection type neoprene mounts, having minimum deflection of 0.35 inch. All metal surfaces shall be neoprene covered, base plate shall have mounting holes, and top shall have threaded steel plate or threaded steel insert. Element shall be color coded or labeled with molded symbols to identify capacity. Mason Series ND, Amber Booth "RV" or approved.
- C. Suspension Isolators: Shall be double deflection neoprene type, with isolator encased in open steel bracket and minimum 3/8-inch deflection. Hanger rod shall be isolated from steel bracket with neoprene grommets. Mason Series HD, Amber Booth "BRD" or approved.

2.03 SPRING ISOLATORS

- A. General: The load carried by each isolator shall be carefully calculated and isolators selected so that the static deflection will be the same and the supported equipment will remain level. Isolators shall be so designed that the ends of the springs will remain parallel during and after deflection to operating height. At operating height, springs shall have additional travel to complete (solid) compression equal to at least 50 percent of the operating deflection. Suspension isolator springs shall have a static deflection (as shown on drawings) not less than 1-1/2", except that for units with components rotating at 1000 rpm and less, the static deflection shall be not less than 2 inches. Floor isolator springs shall have deflection of not less than 1 inch. All isolators shall provide at least 96% isolation efficiency. Note: Deflections other than these may be used where circumstances warrant and more optimum isolation results can be achieved.
- B. Floor Type Spring Isolators: Shall be open spring type with approximate ratio between horizontal and vertical spring constant of 1.0. A ribbed neoprene acoustical friction pad shall

be bonded to the underside of the isolator. Provide with height saving bracket. Mason Series SLF, Amber Booth "SW" or approved.

- C. Floor Housed Type: Housed spring isolator with ductile iron housing, steel base plate with mounting holes, spring inspection ports, neoprene cushion, leveling screws. Mason Series SSLFH, Amber Booth "XLS" or approved.
- D. Suspension Type Spring Isolators: Shall consist of a rigid steel frame, a stable steel spring in the bottom part of the frame, and double deflection neoprene isolating pad at the top of the frame. Where supporting rods pass through the frame, a clearance of not less than one half rod diameter shall be provided all around the rod. Mason Series DNHS, Amber Booth "BSSR" or approved.

2.04 SEISMIC RESTRAINTS

- A. Materials: Steel shall be per ASTM A36; hangers and other devices shall be as shown in "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems". Sheet metal used for bracing shall be no less than 16 gauge. Cable bracing may be used provided that opposed acting cables are provided on the items being braced to provide bracing equal to that provided by rigid angle bracing.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Vibration Isolation:
 - 1. Motorized equipment shall be mounted on or suspended from spring vibration isolators either integral or external to the equipment. Floor mounted or suspended isolators.
 - 2. Unless otherwise indicated, resilient mounts for motorized equipment shall be of the type and size to provide maximum ten percent transmissibility. Use unhoused, free-standing stable steel springs which are preferred over housed spring assemblies. The horizontal stiffness of the spring shall be approximately equal to its vertical stiffness. The spring deflection shall be selected based on the equipment power range (HP), speed range (RPM), and static deflection of the supporting structural floor. For large equipment such as fans the steel spring static deflection of the supporting structural floor. It is a specific recommendation that whenever a steel spring is used, two pads of ribbed waffle-pattern neoprene be used in series with the spring.
 - 3. The design of vibration dampening shall consider lateral load as well as vertical load and be suitably snubbed against earthquake forces.
 - 4. A list of isolators accompanied by certified transmissibility ratings for the required duty shall be submitted for each item of equipment.
 - 5. Unless noted otherwise, all vibration isolating equipment shall be of the same make and shall be submitted as one group.
 - 6. All piping in the mechanical equipment rooms connected to vibrating equipment shall be supported from resilient ceiling hangers or from floor mounted resilient supports.

3.02 SEISMIC CONTROL

- A. Support and bracing from the structure to pipes, ducts and mechanical equipment shall conform to the plumbing & HVAC industry standard SMACNA "Seismic Restraint Manual, Guidelines for Mechanical Systems."

- B. Provide earthquake bumpers for all equipment that is supported on isolators and weighing over 300 lbs. including base. Provide minimum of four bumpers for equipment weighing less than 2,000 lbs., and eight bumpers for heavier equipment.
- C. For equipment 400 lbs or greater, provide lateral force calculations per IBC if required by the building official.
- D. Piping: Longitudinal and transverse bracing shall be required for all piping 2-1/2 inch diameter and larger and on all fuel gas piping 1 inch and larger. Bracing shall be applied as follows:
 - 1. Transverse bracing shall occur at maximum intervals of 40 feet, except on fuel gas piping on maximum intervals of 20 feet.
 - 2. Longitudinal bracing shall occur at maximum intervals of 80 feet, except on fuel gas piping on maximum intervals of 40 feet. Transverse bracing for one pipe section may also act as a longitudinal bracing for a pipe section connected perpendicular to it, if the bracing is installed within 2 feet of the elbow or tee of similar size. Piping conveying fluids at 100°F. and higher shall have expansion devices provided in between longitudinal braces to allow for thermal expansion.
 - 3. Bracing may be omitted when the top of the pipe is suspended 12 inches or less from the supporting structural member and the pipe is suspended by an individual hanger.
 - 4. Seismic bracing for fire sprinkler system shall be as specified per NFPA-13 and but in no case be less than that required in this Section.
 - 5. Provide seismic bracing for hot water tanks.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 STANDARDS

- A. ANSI Compliance: Comply with ANSI A13.1 for lettering size, colors, and installed viewing angles of identification devices.

1.03 SCHEDULES

- A. Submit Valve Schedule for each piping system, typewritten, and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Provide a framed copy of Valve Tag Schedule in the mechanical/janitors room.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURES

- A. Not Applicable.

2.02 PLASTIC PIPE MARKERS

- A. Provide manufacturer's standard preprinted, flexible or semi-rigid, permanent, color-coded, plastic sheet pipe markers.
 - 1. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125° F (52° C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
 - 2. Small Pipes: For external diameters less than 6" (including insulation if any), provide full band pipe markers, extending 360° around pipe and minimum 12" long at each location, fastened by one of the following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap. Laminate or bonded application of pipe marker to pipe (or insulation).
 - c. Strapped to pipe with nylon strap.
 - 3. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Engineer in cases of variance with names as shown or specified.
 - a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.03 PLASTIC TAPE

- A. Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

1. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6".

2.04 PLASTIC VALVE TAGS

- A. Provide manufacturer's standard plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.

2.05 VALVE TAG FASTENERS

- A. Manufacturer's standard solid brass (wire link or beaded type), or solid brass S-hooks of sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.06 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. Provide engraved stock phenolic plastic laminate, complying with FS L-P-387, engraved with engraver's standard letter style of sizes and wording, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 1. Thickness: 1/16" for units up to 20 sq in or 8" length; 1/8" for larger units.
 2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.
 3. Letter Size: No less than 1/2" tall. (Use unit# as noted on the equipment schedules)
- B. Provide for all equipment and signage at emergency shut-offs, etc and on all acid resistant waste and vent piping at 10' intervals stating "Acid Waste".

2.07 PAINT

- A. Benjamin Moore Impervo or equivalent.
- B. Use appropriate primer.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING IDENTIFICATION

- A. Install pipe markers on each system, and include arrows to show normal direction of flow.

3.03 PIPE MARKERS AND COLOR BANDS

- A. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied space, machine rooms, accessible maintenance spaces and exterior non-concealed locations or in accessible ceiling spaces.
 1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floor/ceilings, or enter non-accessible enclosures.

4. At access doors, manholes, and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings omit intermediately spaced markers.
8. Color assignments and stencil for piping identification shall be as listed below (colors used shall be verified with Owner prior to ordering).

<u>Service/Stencil</u>	<u>Color</u>	<u>Stencil</u>
Domestic Cold Water	Green	White
Domestic Hot Water	Green	White
Domestic Hot Water Recir.	Green	White
Waste & Vent Piping	Orange	Black
Sprinkler Work	Red	White

9. Identification stenciling and flow arrows shall be the same color.

3.04 VALVE IDENTIFICATION

- A. Provide valve tag on every valve, cock, and control devices in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn watering hose bibbs, and shut-off valves at plumbing fixtures, and similar rough-in connections of end-use fixtures and units. List each tagged valve in Valve Schedule for each piping system.

3.05 SCHEDULES

- A. Mount Valve Schedule in riser rooms or as directed by Engineer.

3.06 PLUMBING EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign on or near each major item of plumbing equipment and each operation device. Provide signs for the following general categories of equipment and operational devices. Provide signs or suspended ceiling tile below mechanical equipment located above ceiling.
 1. Pumps and similar motor-driven units.
 2. Tanks and pressure vessels.

3.07 CONCEALED ITEMS

- A. Items concealed above accessible ceilings requiring access, shall have the ceiling marked to indicate such items location. The marking system shall consist of colored phenolic plates with ½" tall engraved lettering specifying the item concealed; plate shall be applied to ceiling T-bar framing with rivets or other owner approved method below the concealed item. Colors used shall be verified with Engineer, and unless directed otherwise, shall be:

<u>ITEM</u>	<u>COLOR</u>
Domestic Plumbing System Component	Blue
Fire Protection System Component	Red

- B. Provide three (3) color legends (hard laminate) listing the above colors. Locate as directed by Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 05 29.01 – “Hangers and Supports for Plumbing Equipment”
 - 3. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 4. Section 22 11 17.01 – “Crosslinked Polyethylene (PEX) Piping System”

1.02 GENERAL

- A. Includes, but not limited to, insulating of piping and fittings per schedule in Part 3 of this specification.
- B. Insulation at Hangers: Insulation shall be continuous through hangers on all insulated systems. Inserts at hangers are specified in Section 22 05 29.01 and are considered as part of the hanger and support system. Inserts are required to be installed at the time of pipe installation and are intended to be installed by the Contractor installing the pipe hangers/supports. See Section 22 05 29.01.
- C. The intent of this section is to meet or exceed the requirements of the most current version of the Washington State Energy Code (WSEC). The stricter of this section and WSEC shall be met.

1.03 SECTION INCLUDES

- A. Piping insulation, jackets, and accessories.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. All insulation
- B. Field Applied Jackets

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not applicable

PART 2 - PRODUCTS

2.01 PIPE INSULATIONS

- A. Glass Fiber: Meeting ASTM C547; rigid molded, noncombustible.
 - 1. 'K' Value: 0.23 Btu-in/hr. Ft² °F at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Vapor Retarder Jacket: AP-T PLUS White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.
 - 4. Approved Manufacturers:
 - a. Manville
 - b. Armstrong

- c. Knauf
 - d. Owens Corning
- B. Elastomeric Insulation: Meeting ASTM C534; flexible, closed cell, cellular elastomeric, molded or sheet.
 - 1. "K" Value: 0.25 Btu-in/hr. Ft² °F at 75 degrees F.
 - 2. Maximum Service Temperature of -70 degrees F. to 220 degrees F.
 - 3. Maximum Flame Spread: 25.
 - 4. Maximum Smoke Developed: 25/50 through 1" wall.
 - 5. Maximum water vapor permeability, wet cup, perm-in .10.
 - 6. Connection: Waterproof vapor retarder adhesive as needed.
 - 7. UV-Protection: Outdoor protective coating.
 - 8. Shall have R-Value of 4.2 at 1" and R=8 at 2".
 - 9. The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and WVT.
 - 10. Shall be fiber free, formaldehyde-free, and low VOC's.
 - 11. Approved Manufacturers:
 - a. Armacell
 - b. Kflex
 - c. Aeroflex
- C. Cellular Glass: ASTM C552: "K" value of 0.35 at 75 degrees F; 8.0 lb/cu ft. density.
 - 1. Glass cell insulation, Pittsburgh Corning "Foamglass", with water-vapor permeability of 0.00 perm-inch as tested per ASTM and "pittwrap" heat sealed water-proof membrane.
- D. Field Applied Jackets:
 - 1. PVC Plastic: One piece molded type fitting covers and jacketing material, gloss white.
 - a. Connections: Tacks; Pressure sensitive color matching vinyl tape.
 - b. Manville Zeston 2000.
 - 2. Canvas Jacket: UL listed fabric, 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
 - 3. Aluminum Jacket: 0.016 inch (0.045 mm) thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch (50 mm) laps, die shaped fitting covers with factory attached protective liner.
 - 4. Self-Adhering Jacketing: Material to be VentureClad [1579CW] with a white finish. Jacketing material is to have a maximum flame spread/smoke developed index of 25/20 per UL 723, 1 0.0000 water vapor permeance rating per ASTM E-96, mold inhibitors incorporated, and be UV stable.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Verify that piping has been tested for leakage in accordance with U.P.C. standards before applying insulation materials.
- B. Verify that all surfaces are clean, dry, and free of foreign material.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's recommendations, building codes, and industry standards.
- B. Continue insulating vapor barrier through penetrations except where prohibited by code.
- C. Piping Insulation:
 1. Locate insulation and cover seams in least visible locations.
 2. Neatly finish insulation at supports, protrusions, and interruptions.
 3. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jacket with self sealing laps. Insulate complete system.
 4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions.
 5. Insulated pipe supports and insulation shield shall be in place at each hanger and support as required by Section 22 05 29.01 prior to insulating.
 6. For pipe exposed in mechanical equipment rooms or exposed in finished spaces up to 10 feet above finished floor, finish with Manville Zeston 2000 PVC jacket and fitting covers, self-adhering jacket, or aluminum jacket.
 7. For exterior applications, provide weather protection jacket or coating. Insulated pipe, fittings, joints, and valves shall be covered with Manville Zeston 2000 PVC, self-adhering jacket, or aluminum jacket. Jacket seams shall be located on bottom side of horizontal piping. Install per manufacturer's recommendations.
 8. Insulate trap and hot water supply on ADA compliant lavatories. For rigid piping, insulate with elastomeric foam insulation, 3/8" minimum thickness. See Plumbing Fixture Schedule and Section 22 40 00.01 for ADA compliant lavatory for approved application.

3.03 PIPING INSULATION SCHEDULE

INSULATION TYPE	PIPE SIZE INCH	THICKNESS INCH	
Glass Fiber Insulation:			
Domestic Hot Water, Aboveground	All Sizes	1"	
Cold Water	All Sizes	1"	
Piping Exposed to Freezing or Spaces	All Sizes	1½"	Semi-Heated
Elastomeric Insulation:			
Roof Drain Bodies	All Sizes	1"	

Roof Drainage, First Horizontal Run Body	All Sizes	1"	from Drain
PEX Domestic Hot Water	All Sizes	1"	
PEX Cold Water	All Sizes	Not Required	
Copper Condensate Piping	All Sizes	1/2"	

3.04 FITTINGS, VALVES, STRAINERS, FLANGES, HEADERS, AND EXPANSION COVERS

- A. General: Provide all fitting insulation covers for pipe fittings, grooved end couplings, and for pipe flanges.
- B. Exposed Work: Provide "Zeston PVC" insulated fitting covers applied after pipe insulation is installed. A pre-cut "Hi-Lo Temp" insulation insert, conforming to the UL 25/50 rating, shall be snugly tucked around the fitting making sure the fitting is covered with the full thickness of insulation.
 - 1. All others provide covering in pad form, constructed as follows: Use 1-inch thick Owens-Corning Fiberglas TIW Glass Wool, Type I, non-oiled, fully enclosed on all sides and edges within tight-weave canvas jacket. Attach Bergen hooks around edges of pad. Fit pad to device with edges tightly butted and secure with copper wire laced between hooks. Provide vapor seal where vapor seal is required for adjacent insulation.
- C. The one-piece UL 25/50 rated PVC fitting cover shall be snapped over the insulated fitting and secured with tack fasteners, staples, or tape.
- D. Concealed Downspout Piping and Domestic Cold Water Piping: Zeston fitting covers, stapled, and adhesive sealed to adjacent vapor barrier jacket, same as specified for exposed work.
- E. Gauge Lines: Insulate to the gauge shutoff valve.

3.05 PIPE HANGERS

- A. Do not allow pipes to come in contact with hangers.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 05 29.01 – “Hangers and Supports for Plumbing Equipment”
 - 3. Section 22 11 19.01 – “Piping Specialties”
 - 4. Section 22 13 00.01 – “Soil, Waste, and Vent Piping System”
 - 5. Section 22 21 00.01 – “Sleeves and Seals for Plumbing Equipment”

1.02 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Pipe
- B. Solder

1.03 REFERENCES

- A. ASTM E814: Fire Tests of Through-Penetration Fire Stops.
- B. UL 1479: Through-Penetration Fire Stop Systems.

1.04 QUALITY ASSURANCE

- A. NSF Compliance: NSF 61 for potable water service.

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable.

PART 2 - PRODUCTS

2.01 PIPE (FOR POTABLE SYSTEMS)

- A. Underground Piping (Outside Building Perimeter):
 - 1. Schedule 80 PVC
- B. Underground Piping (Inside Building Perimeter):
 - 1. Type K Copper, ASTM B 88.
 - a. Approved Manufacturers:
 - 1) Mueller
 - 2) Cambridge
 - 3) Nibco
 - 4) Cerro
 - 2. Fittings:
 - a. Solder type (all sizes)
- C. Above Ground Piping:
 - 1. Type L Copper, ASTM B 88:

- a. Approved Manufacturers:
 - 1) Mueller
 - 2) Cambridge
 - 3) Nibco
 - 4) Cerro
- 2. Fittings:
 - a. Solder type (all sizes), or
 - b. Mechanical press type (all sizes):
 - 1) Approved Manufacturers:
 - (a) Viega ProPress
 - (b) Nibco
 - c. NSF 61 Mechanical couplings (2-1/2" and larger):
 - 1) Approved Manufacturers:
 - (a) Victaulic
 - (b) Prior approved equal.
- 3. NSF61 316 L Stainless Steel:
 - a. Fittings:
 - 1) Welded (all sizes), or
 - 2) Mechanical press type (2" and smaller)
 - (a) Approved Manufacturers:
 - (1) Victaulic

2.02 CONDENSATE PIPING

- A. Schedule 40 PVC
- B. Type L Copper if installed in air plenum.
- C. Type L Copper if penetrating a firewall.
- D. Insulate per Section 22 07 19.01.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING AND FITTINGS

- A. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
- B. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site and work into place without springing or forcing.

2. Remove burr and cutting slag from pipes.
 3. Make changes in direction with proper fittings.
- C. Install piping at such heights and in such a manner as to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings. Provide accessible, ground joint unions in piping at connections to equipment.
- D. Coordinate installation of piping with all trades which are affected by installation to avoid conflicts.
- E. Consult all drawings for location of pipe spaces, ducts, electrical equipment, ceiling heights, door openings, window openings, and other details and report discrepancies or possible conflicts to Engineer before installing pipe.
- F. Allow sufficient clearances for installation of pipe insulation in thickness specified. If interferences occur, reroute piping to accommodate insulation.
- G. Make connections of dissimilar metals with insulating couplings. (di-electric unions). See Section 22 11 19.01 – Piping Specialties.
- H. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.
- I. Do not use reducing bushings, street elbows, or close nipples.
- J. T-drill procedure for connecting pipes will not be allowed.
- K. Wrought tees shall be used on all branch piping and branch to main connections.
- L. Bury water piping 6 inches minimum below bottom of slab and encase in 2 inches minimum of sand.
- M. Solder for potable water pipes shall be of a lead free type and shall conform to current UPC standards for solder and all local code requirements.
1. Approved Manufacturers:
 - a. Canfield
 - b. J.W. Harris
 - c. Aqua-Clean
- N. All piping in finished areas shall be installed concealed unless specifically noted otherwise.
- O. Pitch all piping and provide drain valves so that all piping and equipment can be drained.
- P. Provide escutcheons where pipe passes through walls, floors, or ceilings.
- Q. Install all exposed piping parallel to the closest wall and in a neat, workmanlike manner.

3.02 DOMESTIC WATER PIPING TESTS AND STERILIZATION

- A. Tests: As the work progresses each section of the water system shall be tested under a 100psi hydrostatic test held for 2 hours without reduction of pressure (a pressure fluctuation of +/- 1 psi is acceptable). If any leaks occur or piping or valves are found to be defective, same shall be removed and new material installed, and the test made on that section again until all material is found to be satisfactory. Such test shall be made in the presence of the Engineer.

- B. Flushing and Chlorination: All piping shall be flushed to remove all dirt and foreign material. After flushing, all piping shall be chlorinated in accordance with regulations of the Washington State Health Dept. After the contact period, the chlorine shall be drained from the piping and the piping flushed. The Contractor will take samples for bacteriological analysis. The water analysis must be satisfactory before piping is acceptable.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 05 29.01 – “Hangers and Supports for Plumbing Equipment”
 - 3. Section 22 07 19.01 – “Piping Insulation”
 - 4. Section 22 11 19.01 – “Piping Specialties”
 - 5. Section 22 21 00.01 – “Sleeves and Seals for Plumbing Equipment”

1.02 GENERAL

- A. Includes, but not limited to general PEX piping installation for domestic water systems.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Pipe
- B. Fittings
- C. Hangers

1.04 REFERENCES

- A. ASTM F877: Standard specification for cross-linked polyethylene (PEX) plastic hot and cold water distribution systems.
- B. ASTM F1960: Standard specifications for cold expansion fittings with PEX reinforcing rings for use with cross-linked polyethylene tubing.
- C. ANSI/NSF Standard 14: Plastic piping systems components and dedicated materials.
- D. Uniform Plumbing Code: Approved.

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Rehau
- B. Wirsbo

2.02 PIPE (FOR POTABLE SYSTEMS)

- A. Cross-linked polyethylene (Engel)

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING AND FITTINGS

- A. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or

directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.

- B. Properly make adequate provisions for expansion and anchorage.
 - 1. Cut piping accurately for fabrication to measurements established at site and work into place without springing or forcing.
- C. Install piping at such heights and in such a manner as to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings. Provide accessible, ground joint unions in piping at connections to equipment.
- D. Coordinate installation of piping with all trades, which are affected, by installation to avoid conflicts.
- E. Consult all drawings for location of pipe spaces, ducts, electrical equipment, ceiling heights, door openings, window openings, and other details and report discrepancies or possible conflicts to Engineer before installing pipe.
- F. Allow sufficient clearances for installation of pipe insulation in thickness specified. If interferences occur, reroute piping to accommodate insulation.
- G. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.
- H. Pitch all piping and provide drain valves so that all piping and equipment can be drained.
- I. Provide stainless steel inserts at compression stop valves.
- J. All couplings, elbows, tees, reducing tees adapters and any other connecting devices shall be of the same manufacturer as the PEX piping.
- K. Kinked tubing shall be reformed in accordance with manufacturer's recommendation or cut out and replaced.
- L. Fittings shall be plastic or brass
- M. Fittings shall be made by the manufacturers recommended installation tool. Installation tools (with appropriate heads for each size of pipe on the project) shall be delivered to the Engineer at the completion of the job.
- N. 90° direction turns and wall penetrations shall be provided with a bend support or elbow fitting.
- O. Support piping from structure, with fasteners appropriate for adjacent surfaces.
- P. Copper sweated and threaded connections are to be made prior to PEX connections.
- Q. Provide fire stop sealants at fire rated walls. Sealant must be compatible with PEX system.
- R. PEX piping is not to be installed where exposed to direct sunlight. Transition to copper as required.
- S. Tubing ends shall be cut square and free of burrs or debris before connection is made.
- T. PEX tubing shall be fully seated against shoulder of fitting.
- U. Horizontal piping shall be supported every 32".
- V. Vertical piping shall be supported every 4'.
- W. Allow 1/8" to 3/16" of slack per foot of run for expansion and contraction.
- X. PEX tubing shall be installed to allow for expansion and contraction. Do not rigidly attach to structure.

- Y. Provide sleeves where PEX piping passes through masonry walls.
- Z. Protect tubing from nail/screw damage with suitable steel plate protectors.
- AA. The minimum bend radius of PEX tubing is six times its diameter. Smaller radius turns shall be provided with an elbow.
- AB. Install all piping in a neat, workmanlike manner.
- AC. Provide insulators where PEX piping passes through metal studs.
- AD. Supply stops shall be provided with a pipe bracket support from adjacent structure, a pipe clamp, tube talon, and a plastic or metal bend support. (Sioux Chief Universal Slider Bracket or approved equal).

3.02 WATER PIPING TEST AND FLUSHING

- A. Tests: As the work progresses each section of the water system shall be tested under a 125psi hydrostatic test held for 24 hours without reduction of pressure. If any leaks occur or piping or valves are found to be defective, same shall be removed and new material installed, and the test made on that section again until all material is found to be satisfactory. Such test shall be made in the presence of the Engineer.
- B. Flushing and Chlorination: All piping shall be flushed to remove all dirt and foreign material. After flushing, all piping shall be chlorinated in accordance with regulations of the Washington State Health Dept. After the contact period, the chlorine shall be drained from the piping and the piping flushed. The Contractor will take samples for bacteriological analysis. The water analysis must be satisfactory before piping is acceptable. All aerators are to be removed prior to flushing at each fixture.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 3. Section 22 11 17.01 – “Crosslinked Polyethylene (PEX) Piping System”
 - 4. Section 22 11 23.01 – “Pumps”
 - 5. Section 22 20 00.01 – “Excavation and Backfill for Mechanical Underground Utilities”

1.02 GENERAL

- A. Furnish devices as indicated with complete installation procedures for systems.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Thermometers
- B. Gauges
- C. Strainers
- D. Unions
- E. Flexible Connectors
- F. Trap Primers
- G. Thermostatic Mixing Valves and Manufacturers Approved Piping Diagram
- H. Backflow Prevention Devices
- I. Pressure Reducing Valves
- J. Aquastats
- K. Thermal Expansion Tanks

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 THERMOMETERS

- A. Adjustable angle type, 304 stainless steel stem, 5" reading dial type, true anti-parallax-dial black numerals, markings in degrees F., stainless steel, double-strength glass viewing window. Provide sockets with extension necks where installed on insulated piping
- B. Thermometer Temperature Ranges:

<u>Measuring</u>	<u>Range Degree F.</u>	<u>Increments Degree F</u>
Domestic Cold Water	0 – 100	1
Domestic Hot Water	30 – 180	2

- C. Approved Manufacturers:

1. Ashcroft
2. March
3. Taylor
4. Tel-Tru
5. Winters

2.02 PRESSURE GAUGES

- A. Glycerin filled type, 2 ½" reading dial with aluminum face and black numerals, markings in English units, 304 stainless steel case and acrylic lens. Provide each gauge with snubber and needle valve. Provide sockets with extension necks where installed on insulated piping.
- B. Pressure gauge ranges:

Measuring	Range PSIG	Numeral Intervals PSIG	Inter - Graduations
Domestic Hot Water	0 – 160	20	2
Domestic Cold Water	0 – 160	20	2

1. Approved Manufacturers:
- a. Ashcroft
 - b. Marsh
 - c. Taylor
 - d. Tel-Tru
 - e. Winters

2.03 STRAINERS

- A. Water Strainers: "Y" type, same size as the pipe in which they are installed, with bronze bodies rated for 125 psi working pressure, and with removable cover and sediment basket. Basket screen shall be stainless steel or monel, with a net free area of at least 3 times that of the entering pipe. Provide with blowdown valve where shown on the drawings.
- B. Air Strainers: Unless otherwise noted, air and gas line strainers shall be Y-pattern, iron body, 250 psi working pressure, with 40 mesh Monel screen packed with Everdur wool. Air line strainers shall be fitted with brass blowoff cock.
- C. Approved Manufacturers:
1. Armstrong
 2. Bell and Gossett
 3. Apollo
 4. Conbraco
 5. Hoffman
 6. Wheatley
 7. Nibco

2.04 UNIONS

- A. Dielectric Waterways: Inert, non-corrosive thermoplastic lining with zinc electroplated casing, rated at 300 psi at 225 deg. F., conforming to ANSI/NSF 61. Type and size to match piping.
 - 1. Approved Manufacturers:
 - a. Walter Vallett Company V-line
 - b. Clear Flow
- B. Unions on Copper Pipe:
 - 1. In 2-Inch Pipe and Smaller: Wrought copper solder joint copper to copper union.
 - 2. In 2-1/2-Inch Pipe and Larger: Brass flange unions.
 - 3. Approved Manufacturers:
 - a. Watts
 - b. Nibco
 - c. Mueller

2.05 FLEXIBLE CONNECTORS

- A. Water Pump Flexible Connectors: Flexible bronze braid, bronze hose, and copper ends rated to a working pressure of 470 psi at 70°F for a 1" flexible connector.
 - 1. Approved Manufacturers:
 - a. Metraflex
 - b. Minnesota Flex
 - c. Resistoflex

2.06 PIPE SHIELDS (SADDLES)

- A. Saddles shall be minimum, 20 gauge dimpled galvanized sheet steel covering 40% of the circumference of the insulation. Length shall be a minimum of 6". See Section 22 05 29.01 Hangers and Supports for longer shields.

2.07 TRAP PRIMERS

- A. Provide an approved trap primer at each floor drain, funnel drain, shower drain, janitor mop sink, and floor sink.
 - 1. Automatic Trap Primers (Water Pressure Drop Activated): Up to 4 traps may be served by a single trap primer and trap primer distribution system. Automatic primers shall be concealed in every case, located in pipe spaces or wall cavities; and where not accessible in a pipe space, provide an access panel. Elevate trap primer at increments of 12" per 20L.F. of pipe run to trap.
 - a. Approved Manufacturers:
 - 1) Sioux Chief Manufacturing
 - 2) Mifab
 - 2. Automatic Trap Primers (Electronically Activated): Up to 30 trap primers may be served by a single electronic trap primer assembly. Electronic trap primer assemblies shall be provided preassembled with and atmospheric vacuum breaker, preset 24 hour clock,

manual over ride switch/test button, calibrated manifold providing equal water distribution, and a recessed wall box with a locking stainless steel access panel.

a. Approved Manufacturers:

1) PPP (Precision Plumbing Products)

3. Trap primer Tailpieces: 17 GA chrome plated. To be installed on lavatories and hand sinks only. One trap may be served by a single tailpiece trap primer. Provide with stainless steel braided primer hose and escutcheon.

a. Approved Manufacturers:

1) JR Smith

2) Watts

3) Zurn

2.08 BACKFLOW PREVENTION DEVICES

A. Provide letter of certification to Owner.

B. Type and configuration shall conform to local authority requirements.

C. Approved Manufacturers:

1. Apollo Conbraco

2. Wilkins

3. Watts

2.09 PRESSURE REDUCING VALVES

A. Furnish for water service above 70 psi.

1. Type A: 1/2" through 2", adjustable pressure from 25-75 psi, provide 75-100 psi type if higher pressure.

2. Type B: 2" and larger adjustable pressure from 25-75 psi.

3. Approved Manufacturers:

a. Wilkins

b. Watts

c. Apollo Conbraco

2.10 AQUASTATS

A. Automatic Timer Kit:

1. The timer kit shall be UL approved.

2. The timer kit shall be installed on the connection box of the pump.

3. The timer kit will be suitable for 115/120V, 60 HZ operation.

4. The timer shall provide automatic ON-OFF control at minimum interval of every 15 minutes. It shall also have the option of providing manual ON-OFF control.

B. Approved Manufacturers:

1. Bell & Gossett

2. Honeywell

2.11 THERMAL EXPANSION TANKS

- A. Non-ASME Domestic Water Thermal Expansion Tank (For Systems With Water Heaters Less Than or equal to 119 Gallons and/or 199 mbh):
 - 1. The non-ASME domestic water thermal expansion tank shall be IAPMO and NSF listed.
 - 2. The outer shell shall be high grade steel with exterior coating. The bladder shall be FDA approved butyl rubber and prevent water from contact with shell interior. The assembly shall incorporate a schrader valve for adjustable air precharge and lead free bronze system connection. Expansion tank pressure is to set at the domestic water operating pressure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Thermometers: Install thermometers and thermal wells in piping at locations indicated, and so as to be easily read.
- B. Pressure Gauges: Install pressure gauges at each side of pressure reducing valves; and as indicated.
- C. Strainers: Install strainers as indicated. Provide plugged gate or ball valve in blow-off connection on strainers, valve shall be same size as blow-off tapping.
- D. Unions: Install unions in pipe connections to control valves, coils, regulators, reducers, all equipment, and where it may be necessary to disconnect the equipment or piping for repairs or maintenance; and as indicated.
- E. Thermostatic Mixing Valves: Install in accordance to installation detail and the manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”

1.02 SUMMARY

- A. Includes but not limited to:
 - 1. Circulator pumps for plumbing systems.
 - 2. Pumps and motors shall be furnished as one complete unit, including base, flexible connection, and mounting. Pump shall be non-overloading throughout whole length of performance curve. Casing shall be tapped for gauges, unless otherwise indicated. Furnish pump curve with submittal data.
 - 3. Pressure classification of flange connections shall correspond to casing working pressures of 125 psig.
 - 4. Bearings shall be of ball type, either permanently lubricated or provided with ample oil reservoirs, and sealed to prevent loss of oil and entrance of dirt.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Pumps
- B. Pump Curves

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 DOMESTIC WATER IN-LINE PUMPS (CIRCULATORS)

- A. Pumps shall be in-line type for installation in vertical or horizontal piping. Pump must be capable of being serviced without disturbing piping connections.
- B. Pump body shall be of bronze, rated 125 psi working pressure, with gauge ports at nozzles, and with vent and drain ports, if pump(s) is circulating potable hot water, pump body shall be bronze.
- C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew or nut.
- D. The liquid cavity shall be sealed off at the motor shaft by an internally-flushed mechanical seal with ceramic seal seat, and carbon seal ring, suitable for continuous operation at 225°F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.
- E. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces. A flexible coupling to dampen starting torque and torsional vibrations shall be employed.
- F. Motor shall meet NEMA specifications and shall be the size, voltage, and enclosure called for on the plans.

- G. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.
- H. Approved Manufacturers:
 - 1. Armstrong
 - 2. Bell & Gossett
 - 3. Taco
 - 4. Grundfos

2.02 CONDENSATE PUMP

- A. Provide with a one gallon polystyrene tank with pump and automatic float control.
- B. Condensate piping shall be Type L copper or Schedule 40 PVC. See Section 22 11 16.01.
- C. Approved Manufacturers:
 - 1. Little Giant
 - 2. Hartell
 - 3. Liberty

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install with proper support on in-line pumps and vibration isolators under base mounted pumps.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 05 29.01 – “Hangers and Supports for Plumbing Equipment”
 - 3. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 4. Section 22 20 00.01 – “Excavation and Backfill for Mechanical Underground Utilities”

1.02 GENERAL

- A. Includes but not limited to:
 - 1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet out from building, or as indicated.
 - 2. Furnish and install acid waste piping system within building, or as indicated.
 - 3. Perform excavating and backfilling required by work of this Section.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Pipe
- B. Above ground couplings
- C. Below ground couplings
- D. Entire acid waste system (pipe, fittings, procedures)
- E. Acid Neutralization Tank
- F. Solvent Cement

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 SOIL WASTE AND VENT PIPING

- A. Cast Iron:
 - 1. Each piece of cast-iron pipe shall bear the manufacturer's identification mark and shall be certified by the manufacturer to have met the requirements of the latest ASTM specifications.
 - a. Above Ground Waste and Vent: All soil, waste and vent piping above ground shall be:
 - 1) Hubless cast iron pipe and fittings: Conform to ASTM A888 and CISPI 301.
 - (a) Approved Manufacturers:
 - (b) AB&I
 - (c) Charlotte
 - (d) Tyler

- 2) Couplings shall be constructed of 300 Series type stainless steel. There shall be 2 bands for pipe sizes up to 4" and a minimum of 4 bands for pipe sizes 5" and larger. Sealing bands shall require a minimum of 60-inch lbs. torque per band. Neoprene gasket shall meet ASTM C 564.
- 3) Approved Above Ground No Hub Couplers:
 - (a) Thermafit-Regular Duty
 - (b) Tyler-Standard No-Hub
 - (c) Clamp-All Corp. - HI-TORQ 80
- b. Below Ground Waste and Vent: All soil and waste vent below ground shall be:
 - 1) Hubless Cast Iron Pipe and Fittings: Conform to ASTM A 888 & CISPI 301.
 - (a) Approved Manufacturers:
 - (b) AB&I
 - (c) Charlotte
 - (d) Tyler
 - 2) No Hub Coupling: Couplings shall be constructed of 300 Series type stainless steel with a minimum shield thickness equal to 0.015. There shall be 2 bands for pipe sizes up to 4" and a minimum of 4 bands for pipe sizes 5" and larger. Coupling shall be capable of holding 15 psi of pressure. Sealing bands shall have a minimum thickness of 0.026 and require a minimum of 80-inch lbs. torque per band. Neoprene gasket shall meet ASTM C 564.
 - 3) Approved No Hub Coupling Manufacturers:
 - (a) Clamp-All Corp. - HI-TORQ 80
 - (b) Thermafit-Heavy Duty
- c. Belowground Waste and Vent Beyond 5' From The Building: All soil, waste, and vent piping below ground shall be:
 - 1) Plastic piping: ANSI/ASTM D2665-94 (PVC).
 - 2) Fitting: Comply with current UPC.
- B. PVC Soil Waste and Vent Piping:
 1. Each pipe of PVC pipe shall bear the manufacturers identification mark and shall be certified by the manufacturer to have met the requirements of the latest ASTM specifications.
 2. Aboveground: All aboveground soil, waste and vent piping and fittings shall be type DWV and comply with ASTM D 2665, ASTM D 2949, ASTM F 891, ASTM F 1488 and CSA CAN/CSA-B181.2.
 3. Belowground: All below ground soil, waste and vent piping and fittings shall be type DWV and comply with ASTM D 2665, ASTM D2949, ASTM F891 and CSA CAN/CSA-B181.2.
 4. Below Ground PVC Waste and Vent Piping Beyond 5' Outside Building: Shall be type DWV and comply with ASTM D 2665, ASTM D 2949, ASTM D 3034, ASTM F 891, CSA B 182.2 and CSA CAN/CSA-B182.4.
 5. Joints:

- a. Mechanical Joints: Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA CAN/CSA-B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions.
 - b. Solvent Cementing: Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA CAN/CSA-B137.3, CSA CAN/CSA-B181.2 or CSA CAN/CSA-B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.
 - c. Threaded Joints: Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.
- C. ABS Soil Waste and Vent Piping:
1. Each pipe of ABS pipe shall bear the manufacturers identification mark and shall be certified by the manufacturer to have met the requirements of the latest ASTM specifications.
 2. Aboveground: All aboveground soil waste and vent piping and fittings shall be type DWV and comply with ASTM D 2661, ASTM F 628, CSA B181.1.
 3. Belowground: All belowground soil waste and vent piping and fittings shall be type DWV and comply with ASTM D 2661, ASTM F 628, CSA B181.1.
 4. Belowground ABS Waste and Vent Piping Beyond 5' Outside Building: Shall be type DWV and comply with ASTM D 2661, ASTM D 2751 and ASTM F628.
 5. Joints:
 - a. Mechanical Joints: Mechanical joints on drainage pipe shall be made with an elastomeric seal conforming to ASTM C 1173, ASTM D 3212 or CSA CAN/CSA-B602. Mechanical joints shall not be installed in above-ground systems, unless otherwise approved. Joints shall be installed in accordance with the manufacturer's instructions.
 - b. Solvent Cementing: Joint surfaces shall be clean and free from moisture. A purple primer that conforms to ASTM F 656 shall be applied. Solvent cement not purple in color and conforming to ASTM D 2564, CSA CAN/CSA-B137.3, CSA CAN/CSA-B181.2 or CSA CAN/CSA-B182.1 shall be applied to all joint surfaces. The joint shall be made while the cement is wet and shall be in accordance with ASTM D 2855. Solvent-cement joints shall be permitted above or below ground.
 - c. Threaded Joints: Threads shall conform to ASME B1.20.1. Schedule 80 or heavier pipe shall be permitted to be threaded with dies specifically designed for plastic pipe. Approved thread lubricant or tape shall be applied on the male threads only.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Do not caulk threaded work.
- B. Place cleanouts as follows:
 1. Where shown on Drawings and near bottom of each stack and riser.
 2. At every 135 degree change of direction for horizontal lines.

3. Every 100 feet of horizontal run.
 4. Extended cleanout to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
- C. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system so gases pass freely to atmosphere with no pressure or siphon condition on water seal.
- D. Vent entire waste system to atmosphere. Discharge vent pipe minimum 14 inches above roof. Join lines together in fewest practicable number before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley.
- E. Use torque wrench to obtain proper tension in cinch bands on above ground hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- F. Flash pipes passing through roof with 4 lbs. per sq. ft. of sheet lead flashing (or as shown on the plan) fitted snugly around pipes and caulk between flashing and pipe with flexible waterproof compound. Extend lead up and turn in to pipe for min. 1"/vent. Flashing base shall be at least 24 inches square.
- G. Grade soil and waste lines within building perimeter 1/4 inch fall per ft. in direction of flow.
- H. Installation shall comply with all the latest local plumbing, building, and fire code requirements. Solvent cement joints shall be made in a two-step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564, test installation with water.

3.02 FIELD QUALITY CONTROL

- A. Before piping is covered, conduct tests for leaks and defective work. Notify Architect prior to testing. Correct leaks and defective work. Fill waste and vent system to roof level with water, 10 feet minimum, and show no leaks for two hours.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 2. Section 22 13 00.01 – “Soil, Waste and Vent Piping System”

1.02 GENERAL INCLUDES

- A. Excavation and Associated Grading.
- B. Trenching and Trench Protection.
- C. Backfilling and Compaction.
- D. Verification of Existing Utilities.
- E. Protection of Utilities.

1.03 QUALITY ASSURANCE

- A. Inspection of Job Conditions: Prior to starting work and during work, the Contractor shall examine the work by others, site and job conditions under which excavation, trenching, and backfilling for underground utilities work will be performed to ensure satisfactory conditions exist to proceed with work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Codes and Standards: Comply with requirements of the following codes and standards (Latest Edition) except as modified herein:
 - 1. International Conference of Building Officials, "Uniform Building Code".
 - 2. Local requirements for all utility work.
 - 3. OSHA and WISHA regulations.
 - 4. APWA Standard Specifications.

1.04 RESPONSIBILITY

- A. The Contractor is solely responsible for compliance with the requirements of the drawings, specifications, local codes and standards, proper construction coordination with work of other trades, and protection and worker's safety. Contractor shall advise the Engineer of any discrepancy in, or disagreement with the specifications and/or drawings prior to starting work and not proceed until issue is resolved. Commencement of work shall indicate Contractor's acknowledgement of his expertise in this type of work. Any delay resulting from failure to comply with this procedure will not be basis for an extension of the completion date.

1.05 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced.
- B. American Society of Testing and materials (ASTM) publications:
 - D 422-63 Particle Size Analysis of Soils.
 - D 423-66 Liquid Limit of Soils.
 - D 424-59 Plastic Limit and Plasticity Index of Soils.

D 1557-78 Moisture Density Relations of Soils using a 10 lb. (4.54kg) Rammer and 18 inch (457 mm) Drop.

D 2167-66 Density of Soil In-Place by the Rubber Balloon Method.

D 2217-66 Wet preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Contents.

D 2487-69 Classification of Soils for Engineering Purposes.

D 2922-81 Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth).

E 548-79 Generic Criteria for Use in the Evaluation of Testing and Inspection Agencies.

1.06 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

A. Not Applicable

PART 2 - MATERIALS

2.01 APPROVED MANUFACTURERS

A. Not applicable

2.02 SATISFACTORY MATERIALS

A. Materials classified as ASTM D2487, Unified Soil Classification System as SW, SP, GW, and GP are satisfactory for backfill use. Materials classified as SP-SM, GP-GM, GM, GC and ML are also satisfactory for backfill use provided that they contain moisture contents suitable for the intended use and are reasonably free of organic matter. Native material, not considered unsatisfactory as specified below, may comply. Except that no material shall have any object with a dimension exceeding 2 inches.

2.03 UNSATISFACTORY MATERIALS

A. Materials classified in ASTM D2487, Unified Soil Classification System as PT, OH, and OL are unsatisfactory. Unsatisfactory materials also include man-made fills, refuse and all materials containing excessive organic matter or having moisture contents which are not suitable for the intended use, or having objects with dimensions exceeding 2 inches (boulders, etc.).

2.04 UNSTABLE MATERIAL

A. Unstable material shall consist of material too wet to properly support the utility pipe, conduit or appurtenance structure.

2.05 GRAVELLY SAND BORROW MATERIAL

A. Gravelly sand borrow material to provide backfill, or replace unsuitable soil, shall meet the requirements of SW, SP, GW, and GP materials, as noted in Table 2.1, except that the maximum percentage passing the No. 200 sieve shall not exceed 5% based on the soil fraction passing the U.S. No. 4 sieve, and not contain discrete particles greater than 2 inches in diameter.

2.06 DEGREE OF COMPACTION

A. Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557, Method C. Minimum compaction requirements shall be as specified in PART 3.

2.07 DRAINAGE GRAVEL

A. Shall be 3/4 inch washed gravel with no more than 2% passing 1/2 inch sieve opening.

2.08 SPECIAL BEDDING AND INITIAL BACKFILL MATERIAL

A. Minus 3/8 inch washed pea gravel.

TABLE 2.1				
Unified Soil Classification (USC) System (from ASTM D 2487)				
Major Divisions			Group Symbol	Typical Names
Course-Grained Soils More than 50% retained on the No. 200 sieve	Gravels 50% or more of course fraction retained on the No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of course fraction passes the No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays

	OH	Organic clays of medium to high plasticity
Highly Organic Soils	PT	Peat, muck, and other highly organic soils

Prefix: G = Gravel, S = Sand, M = Silt, C = Clay, O = Organic Suffix: W = Well Graded, P = Poorly Graded, M = Silty, L = Clay, LL < 50%, H = Clay, LL > 50%

PART 3 EXECUTION

3.01 EXCAVATION

- A. If workers enter any trench or other excavation four or more feet in depth that does not meet the open pit requirements of WSDOT Section 2.09.3(3)B, it shall be shored and cribbed. The Contractor alone shall be responsible for worker safety. All trench safety systems shall meet the requirements of the Washington Industrial Safety and Health Act, Chapter 49.17 RCW.
- B. Excavation of every description and of whatever substances encountered shall be performed to allow the installation of all utilities at the lines and grades as required. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material.
- C. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the Port.
- D. For all use of excavated material refer to Section 01 35 43.19.
- E. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. Unauthorized over-excavation shall be backfilled in accordance with paragraph 3.05 BACKFILLING at no additional cost to the Port.
- F. The Contractor shall provide any dewatering needed and is considered incidental to the Contract.

3.02 TRENCH EXCAVATION

- A. The trench shall be excavated as recommended by the manufacturer of the pipe to be installed unless shown otherwise on the drawings. Where recommended trench widths are exceeded, redesign shall be performed by the Contractor using stronger pipe or special installation procedures. The cost of this redesign and the increased pipe or installation procedures shall be borne by the Contractor without additional cost to the Port.
- B. Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe and for bedding. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.
- C. Removal of Unsuitable Material: Where unsuitable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph 3.05 BACKFILLING. When removal of

unsuitable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Port.

- D. Bedding: The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. The pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of pipe or arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth and width as required for properly making the particular type joint. Provide bedding using pea gravel where noted on the drawings.

3.03 JACKING, BORING, AND TUNNELING

- A. Unless otherwise indicated, excavation shall be by open cut, except that sections of a trench may be jacked, bored, or tunneled if the pipe, cable or duct can be safely and properly installed and backfill can be properly tamped in such sections.

3.04 BACKFILLING

- A. Backfill material shall be compacted to 6" layers and as specified in Paragraph 3.07.
1. Trench Backfill: Trenches shall be backfilled to finish grade. The trench shall be backfilled to above the top of pipe prior to performing the required pressure tests (except that where piping requires insulation, the pipe shall have an initial test prior to insulating and then a final test as specified herein). The joints and couplings shall be left uncovered during the pressure test.
 2. Replacement of Unstable Material: Unstable material removed from the bottom of the trench of excavation shall be replaced with select granular material or gravel borrow placed in layers not exceeding 6 inches loose thickness.
 3. Bedding and Initial Backfill: Bedding shall consist of satisfactory materials. Initial backfill shall be in 6 inch lift.

3.05 SPECIAL REQUIREMENTS

- A. Special requirements for excavation, backfill, and bedding relating to the specific utilities are as follows:
1. Combination Fire/Water Lines: Trenches shall be a depth to provide a minimum cover of 3.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. Bedding shall use "special bedding" materials as specified in paragraph 2.07.
 2. Domestic Water Lines: Trenches shall be of a depth to provide a minimum cover of 3.0 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. Except that branch lines serving individual fixtures within building footprint shall have minimum of 1.0 foot cover. Bedding shall use "special bedding" materials as specified in paragraph 2.07.
 3. Where piping passes under footings, provide concrete fill starting 12 inches above pipe for excavated length and width of footing above pipe for footing support. Concrete specification shall match same provided for footing.

3.06 COMPACTION

- A. Each layer of fill, or the excavated subgrade, shall be compacted to at least 95%, per ASTM D1557, of laboratory maximum density. Compaction shall be accomplished by approved

tamping rollers, pneumatic-tired rollers, three-wheel power rollers, or other approved compaction equipment.

3.07 PROTECTION

- A. Newly graded excavated or bedded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades reestablished to the required elevations and slopes.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”

1.02 GENERAL

- A. Includes sleeving and sealing of plumbing piping.

1.03 REFERENCES

- A. ASTM E814: Fire Tests of Through-Penetration Fire Stops
- B. UL 1479: Through-Penetration Fire Stop Systems.

1.04 SUBMITTAL REQUIREMENTS

- A. Submittal requirements for this Section.
 - 1. Seals

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Products shall comply with Section 20 00 00.01, paragraph 2.01, Approved Manufacturers.
- B. Fire Seals: 3M, Dow Corning, General Electric, Rectorseal Metacaulk.

2.02 PIPE SLEEVES

- A. Size: Inside diameter of pipe sleeves shall be at least 1/2-inch larger than the outside diameter of the pipe or pipe covering, so as to allow free movement of piping.
- B. Ends: Sleeve ends shall be cut flush with finished surfaces, except in rooms having floor drains where sleeves shall be extended 3/4-inch above finished floor.
- C. Material - Structural: Sleeves through structural elements shall be fabricated from Schedule 40 steel pipe.
- D. Material - Non-structural: Sleeves through non-structural elements shall be fabricated from 18 gauge galvanized sheet metal or 24 gauge spiral duct.
- E. De-burr pipe ends and smooth slab penetration (to accept final slab finish) from sleeves extending above finished floor.

2.03 SEALS

- A. Seals in Interior Fire Rated Assemblies: Shall be tested in accordance with ASTM E814 and shall be UL classified per UL 1479 as a through-penetration fire stop device.
- B. Seals in Exterior Masonry Walls and Floors:
 - 1. Piping: Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. The seal assembly shall expand when mechanically tightened to provide an absolute watertight seal between the pipe and

wall opening. Sizing shall be per manufacturer's recommendations. Seal shall be Thunderline "Link-Seal" or approved equal.

- C. Seals In Other Areas: Packed fiberglass or wool insulation, where no weatherproofing or adhesive properties are required; otherwise, sealants shall be silicone type.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE SLEEVES

- A. Provide pipe sleeves for all piping passing through walls, floors, partitions, roofs, foundations, footings, grade beams, and similar elements, except that sleeves are not required for penetrations through existing single solid elements, having no voids, at the location where the piping passes through the solid elements (e.g., solid wood stud, core drilled solid concrete, etc.). Where a sleeve is required, such sleeve shall continue all the way through any solid items within that element.
- B. Set sleeves plumb or level (or sloped as required for drainage pipe) in proper position, tightly fitted into the work.
- C. Fill openings around outside of pipe sleeve with same material as surrounding construction, or with material of equivalent fire and smoke rating.
- D. Seal around all pipes inside of pipe sleeve.
- E. Insulation shall run continuous through sleeves in non-fire rated elements. Insulation shall not run continuous through sleeves in fire rated elements unless the fire sealant system used is UL accepted for use with insulated pipes.
- F. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade.

3.02 INSTALLATION OF SEALS

- A. Provide seals around all piping passing through walls, floors, roofs, foundations, footings, grade beams, partitions, and similar elements.
- B. Seals shall be of material and workmanship to maintain the fire and smoke rating of element being penetrated. Seals ability to maintain the rating of the element being penetrated shall be listed in UL Laboratories Building Materials Directory or otherwise confirmed by an approved listing agency. It shall be the Contractor's responsibility to submit shop drawings and technical data showing seals and systems proposed, and corresponding agency approval. The Contractor shall also be responsible to submit any data as required by local agencies to satisfy them that the Contractor's proposed fire seals are satisfactory.
- C. Seals shall be watertight where the penetration may be exposed to water or moisture.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 05 48.01 – “Vibration and Seismic Control”
 - 3. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”

1.02 GENERAL

- A. Includes, but not limited to, furnishing and installing specified system.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Water heaters.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. State
- B. Lochinvar
- C. Rheem/Ruud
- D. Bradford White
- E. PVI

2.02 HEATER

- A. This water heater(s) shall be as scheduled and listed by Underwriter's Laboratories. Heater(s) shall have a maximum working pressure of 150 psi with a separate 3/4" tapping for relief valve installation and a rigidly supported anode rod for maximum cathodic protection. All internal surfaces of the heater(s) exposed to water shall be glass-lined with an alkaline borosilicate composition fused-to-steel. Electrical heating element(s) shall be low watt density incoloy sheath, screw-in design. The controls shall include a thermostat with each element and a high temperature cutoff. The jacket shall provide full size control compartments for performance of service and maintenance through front panel openings and enclose the tank with foam insulation. The drain valve shall be located in the front for ease of servicing. Outer jacket shall be baked enamel finish. Heater(s) shall have a 3 year limited warranty covering the tank, thermostats, high limit and heating elements as outlined in the written warranty. Fully illustrated instruction manual to be included. Heater(s) shall meet ASHRAE Standard 90.1b-1990 for energy efficiencies and the minimum energy factor required by the Federal "National Energy Conservation Act of 1987".

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Water heaters shall each have a relief valve sized to match heat input and set to relieve at 120 psi.

- B. Install temperature-pressure relief valve on hot water heater and pipe discharge directly above funnel of floor drain or as shown on plans.
- C. If system has a hot water recirculating line and/or check valve in the cold water supply to tank, provide a pre-charged, diaphragm type expansion tank "Amtrol" Model AST or approved equal. Size per schedule on Hot Water Tank Piping Diagram.
- D. Water heaters installed in unconditioned space or on a concrete floor shall be placed on incompressible insulation having a minimum insulation value of R-10.
- E. Provide and install seismic bracing per S.M.A.C.N.A. zone 3.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 3. Section 22 11 17.01 – “Crosslinked Polyethylene (PEX) Piping System”

1.02 SUMMARY

- A. Includes, but not limited to, furnishing and installing specified plumbing fixtures. Provide and install soft flow aerators on all lavatories and sinks (service sinks not included). See 3.03 for energy conservation devices.

1.03 QUALITY ASSURANCE (REGULATORY REQUIREMENTS)

- A. Installation shall meet requirements of local codes and manufacturer's instructions.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. All plumbing fixtures in this section and called out on the plans.
- B. Floor drains.
- C. Clean outs.
- D. Carriers.
- E. Hydrants.
- F. Hose Bibbs.

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Vitreous China And Cast Iron Fixtures:
 - 1. American Standard
 - 2. Mansfield
 - 3. Kohler
 - 4. Toto
 - 5. Zurn
 - 6. Sloan
- B. Stainless Steel Sinks:
 - 1. Just
 - 2. Elkay
- C. Supply Stops:

1. Chicago Faucets "STB" Series, Loose Key
 2. Engineered Brass Company (EBC) "LAH" Series, Loose Key
 3. BrassCraft "KT" Series, Loose Key
- D. Faucets:
1. Chicago Faucets
 2. Zurn
 3. Symmons
 4. Toto
 5. Speakman
 6. Moen
 7. Delta
- E. Waste:
1. EBC
 2. Just
 3. Elkay
- F. Traps:
1. EBC
 2. Just
 3. Elkay
 4. Dearborn Brass
- G. Flush Valves:
1. Sloan
 2. Zurn
 3. Geberit
 4. Toto
 5. Moen
- H. Stainless Steel Lavatories and Water Closets:
1. Bradley
 2. Willoughby Industries
 3. Acorn
- I. Multi-Use Wash Fountains:
1. Bradley
 2. Willoughby Industries
 3. Intersan

4. Acorn

J. Drinking Fountains:

1. Halsey Taylor
2. Haws
3. Oasis
4. ElKay
5. Acorn

K. Service Sinks:

1. Florestone
2. Fiat

2.02 FIXTURES

- A. See Schedule on Drawings.

2.03 FLOOR DRAINS (F.D.)

- A. Cast iron body floor drain, with 5" nickel bronze adjustable strainer head, vandal proof screws, and trap primer connections. Size outlet to match pipe size shown on drawings. Where used for shower drain, provide with chrome plated strainer. Furnish with 6" diameter strainer and funnel where indicated.
- B. Cast iron body floor drain, with Type 'N' 7" diameter, nickel bronze grate, vandal proof screws, and trap primer connections. Size outlet to match pipe size shown on drawings. Use in mechanical rooms and utility spaces.
- C. Approved Manufacturers: J.R. Smith, Zurn, Wade

2.04 FLOOR SINKS

- A. 12x12x6 deep cast iron body and square slotted light duty grade, with white acid resisting porcelain enamel interior and top, complete with white ABS anti-splash interior bottom dome strainer.
- B. Approved Manufacturers: J.R. Smith, Zurn, Wade

2.05 CLEANOUTS

A. Finish Floors:

1. Zurn ZN-1400
2. Smith #4023X
3. Wade #W-6000
4. Josam #56010

B. Resilient Flooring:

1. Zurn ZN-1400-X
2. Smith #4143
3. Wade #W-6000-T
4. Josam #56010-12

C. Finished Wall:

1. Zurn Z-1468
2. Smith #4472
3. Wade #W8460R
4. Josam #58890

D. Exposed Drain Lines:

1. Zurn Z-1441
2. Smith #4402
3. Wade #W8560A
4. Josam #58510

E. General Purpose:

1. Zurn Z-1441
2. Smith #4402
3. Wade #W8550A
4. Josam #58500

2.06 CARRIERS

A. WC carrier in stud wall with plumbing chase (Heavy duty type):

1. J.R. Smith: 200 Series (Adjustable type)
2. Zurn: Z-1200 Series (Adjustable type)
3. Wade: W300 Series (Adjustable type)

B. Urinal carriers in stud wall:

1. J.R. Smith: 0637
2. Zurn: Z-1222
3. Wade: W400

C. Lavatory carriers in stud wall:

1. J.R. Smith: 0700 (0700Z for 2x4 stud wall)
2. Zurn: Z-1231
3. Wade: W520

D. Lavatory carriers in plumbing chase wall:

1. J.R. Smith: 0720
2. Zurn: Z-1253
3. Wade: W571

2.07 HYDRANTS

A. Wall Hydrants: Approved freeze-proof type with integral anti-siphon device:

1. Zurn: Z-1310
2. Wade: W-8620 with union elbow
3. Smith: 5609
4. Josam: 71050
5. Woodford: 65
6. Jones Spec: 51010

2.08 HOSE BIBBS

- A. Approved types with integral vacuum breaker, chrome plated face and loose key. J.R. Smith FIG 5618.

2.09 STAINLESS STEEL SINK

- A. All stainless steel drop-in-bowl sinks shall be seamless 18 gauge type 304 and have corrosion resistant mounting channel, sprayed on sound deadening compound fully coating underside of sink, and polished surface. Verify amount of hole punches required for each sink prior to ordering.

2.10 SENSOR FAUCET

- A. The sensor faucet shall be battery powered, have an infrared convergence type proximity sensor battery compartment, access to controls and battery through spout. Provide with vandal resistant aerator as indicated on plans, cover plate to match hole pattern of lavatory, and supply hose(s). The spout and cover plate shall be chrome plated cast brass.

2.11 POINT-OF-USE THERMOSTATIC MIXING VALVE

- A. Provide point-of-use thermostatic mixing valve with a temperature adjustment range between 90-140°F.
- B. Mixing valve shall be rated for a minimum flow of 0.25 g.p.m certified to ASSE 1070 and a maximum pressure of 125 psi, and 200°F maximum hot water temperature.
- C. Mixing valve body shall be comprised of lead free bronze with locked temperature adjustment cap, and integral check valves on the hot and cold inlets.
- D. Approved Manufacturers:
 1. Leonard
 2. Bradley
 3. Watts

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation: Install fixtures including traps and accessories with accessible stop or control valve in each hot and cold water branch supply line.
- B. Mounting: Verify mounting height with architectural elevations. Architectural elevations take precedent over these heights.
 1. ADA Fixtures:
 - a. Toilet: 17" to 19" to top of seat.

- b. Urinal: 16" from floor to bottom lip.
 - c. Lavatory: 29" minimum clearance under fixture, maximum of 33" to rim.
 - d. Drinking Fountain: Bubbler height shall be less than 36" from finished floor with 27" minimum clearance underneath.
2. Standard Fixtures:
- a. WC: 14" to 16" to rim from floor.
 - b. Urinal: 24" from floor to bottom lip.
 - c. Lavatory: 29" from floor to top of apron.
 - d. Drinking Fountain: Bubbler height shall be a minimum of 38" from finished floor.
- C. Make fixture floor connections with approved brand of cast iron floor flange, soldered or caulked securely to waste pipe.
- D. Make joints between fixtures and floor flanges tight with approved fixture setting compound or gaskets.
- E. Caulk between fixtures and wall and floor with white butyl rubber non-absorbent caulking compound. Point edges.
- F. Provide concealed arm supports for wall mounted china lavatories.
- G. All exposed metal shall be chrome-plated brass.
- H. Provide concealed heavy steel stanchion and supporting plate for lavatories and urinals.
- I. Provide floor-mount fixture support for wall-hung water closets, and with 2" no-hub auxiliary inlet at each location of back to back water closet and urinal.
- J. Flush valve supply pipe must be anchored and backed securely -- installation must be approved by engineer prior to concealing.
- K. Provide flush valve supply support on all WC and urinal carriers.
- L. Provide rear anchor support for all heavy-duty WC carriers.
- M. All fixture mounting heights shall be verified or determined on site prior to installation. Coordinate with architectural drawings.
- N. Install (1) bellows type water hammer arrester (at each quick acting valve). Jay R. Smith Hydrotrol, Sioux Chief Manufacturing, Zurn Shoktrol or approved equal and for branch supply lines up to 20' in length serving plumbing fixture groups. Install water hammer arrester between last two fixtures, for branch supply lines exceeding 20' in length, serving plumbing fixture groups install water hammer arrester between middle two fixtures and last two fixtures, sizes as indicated in the table below.

Water Hammer Arrester Table

<u>Fixtures Units</u>	<u>Water Hammer Arrester Size</u>
1-11	JR Smith #5005 (4" High Shell)
12-32	JR Smith #5010 (5" High Shell)
33-60	JR Smith #5020 (6" High Shell)
61-113	JR Smith #5030 (7" High Shell)

114-154

JR Smith #5040 (8" High Shell)

- O. Provide trap primer and connection to p-trap of showers, floor sinks, floor drains, and service sinks.
- P. ADA showers shall be installed with entrance lip flush with finish floor.
- Q. On ADA water closets, provide flush valve handle or tank handle on side facing wheelchair turn around.
- R. All ADA lavatory P-trap and angle stop assemblies shall be insulated with institutional A.D.A. insulator kit as manufactured by E.B.C. or equal. Abrasion resistant exterior cover shall be smooth and have 1/8" wall minimum over cushioned foam insert. Fasteners shall remain substantially out of sight. Use part 500RHS on offset P-trap if required.
- S. Sensor Type Fixtures: Contractor to coordinate with for installation of all infra-red sensor type fixtures. Transformer kit provided and installed by contractor. All electrical connectors, wire connections, and testing by contractor.
- T. Hose Bibb: Install one (1) hose bibb in each toilet room with 2 or more water closets, urinals or a combination there of, mount at 18" under one lavatory.
- U. Wall Hydrant: Install at 18" above finished grade, unless otherwise indicated.
- V. Lavatory, Classroom, and Hand Sink Faucets: Set hot water delivery temperature at 105°F. Faucets without a mechanical temperature limit stop shall be provided with a point of use thermostatic mixing valve.

3.02 ADJUSTING, CLEANING

- A. Polish chrome finish at completion of Project.
- B. Remove all manufacturers' labels tags, and protective plastic.
- C. Clean all fixtures.
- D. Polish floor drain covers.

3.03 ENERGY CONSERVATION

- A. Provide flow controls on all fixtures to limit flow as indicated:

<u>Fixture</u>	<u>Standard</u>
Flushometer-valve WC	1.6 gal. (6.0 liters) per flush
Urinals-manual operated flushometer	1.0 gal. (3.78 liters) per flush
Urinals-sensor operated flushometer	0.125 gal. (0.5 liters) per flush
Lavatory Faucets (metered)	2.5 gal. (9.5 liters) per minute
Lavatory Faucets (non metered)	0.5 gal. (1.89 liters) per minute
Kitchen Faucets	2.5 gal. (9.5 liters) per minute
Public Lavatory Faucets (other than self-closing)	0.5 gal. (1.89 liters) per minute
Replacement Aerators	2.5 gal. (9.5 liters) per minute

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”

1.02 GENERAL

- A. Includes, but not limited to, furnishing and installing specified system. Handicapped type must comply with ADA.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Water Coolers.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Haws
- B. Elkay
- C. Oasis
- D. Halsey Taylor
- E. Sunroc

2.02 STANDARD FOUNTAIN (WALL MOUNTED)

- A. 8 gph of 50°F water cooled from 80°F inlet water with 90°F room temperature. 1/5 HP motor. 115-volt, 60 Hz, single- phase. Bubbler shall be chrome plated brass. Fountain must be ADA approved and be installed per local codes.

PART 3 - EXECUTION

3.01 GENERAL

- A. Anchor bottom of fountain to wall. Bubbler height to be a maximum 36 inches above finish floor. Also, clear knee space between the bottom of the apron and the floor shall be at least 27 inches high.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 20 00 00.01 – “General Mechanical Requirements”

1.02 GENERAL

- A. Includes, but not limited to, motors 1 HP or larger used in Division 23.

1.03 SUBMITTALS REQUIREMENTS OF THIS SECTION

- A. All variable drives.
- B. Total harmonic voltage distortion calculation.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Check out sheet for each variable drive showing all programmed parameters. Date of check out, and name and company address of employee responsible for checkout.
- B. Programming manual explaining how to access and change all programmable points.
- C. International wiring diagram for each different unit.
- D. Parts diagram with replacement parts listed.
- E. Trouble shooting guide.

PART 2 - PRODUCTS

2.01 MOTORS

- A. Motors located indoors shall be open frame, drip-proof type, unless indicated otherwise. Motors located outdoors exposed to weather shall have corrosion resistant finish and shall be totally enclosed fan cooled (TEFC) or totally enclosed non-ventilated (TENV) type, unless indicated otherwise. Motors used in fans serving dishwashing hoods shall be TEFC type.
- B. All motors shall be UL listed.
- C. All motors used with variable frequency drives shall be premium efficiency inverter ready and shall be capable of running at a minimum of 85 Hz.
- D. All motors 1 HP and larger shall be energy efficient type and shall meet the 2012 Washington State Energy Code requirements.
- E. Motors shall not be smaller than indicated on drawings; however, motors shall be of adequate size to drive the respective equipment when handling the quantities specified without exceeding the nameplate full load current at any conditions encountered in actual operation. If it becomes evident that a motor furnished is too small to meet these requirements as a result of the Contractor using substituted equipment or having revised the system arrangement, the Contractor shall replace it with a motor of adequate size at no additional cost to the Port. This Contractor shall also arrange to increase the size of the wiring, motor starter and other accessories as required to serve the larger motor at no additional cost to the Port.
- F. Approved Manufacturers:
 - 1. General Electric
 - 2. Westinghouse

3. Reliance
4. Allis-Chalmers
5. Gould
6. Century
7. Wagner
8. Baldor
9. U.S. Motors Marathon

2.02 VARIABLE FREQUENCY DRIVES

A. Variable Frequency Drives (VFD):

1. Description:
 - a. Provide enclosed adjustable speed drives suitable for operating at the current, voltage, and horsepower indicated on the equipment schedule. Conform to requirements of NEMA ICS 3.1.
 - b. VFD shall not increase the voltage distortion above 5% at the input terminals of the VFD or line filters. The manufacturer shall make all modifications to the drive necessary to meet this requirement.
 - c. VFDs shall be used with terminal unit fans only.

B. Ratings:

1. VFD must operate, without fault or failure, when voltage varies plus or minus 10 percent from rating and frequency varies plus or minus 5 percent from rating.
2. VFD shall be voltage as shown on schedule.
3. Operating Ambient Temperature: 14 degrees F to 104 degrees F.
4. Humidity: non-condensing to 95%.
5. Altitude: to 3300 feet, higher altitudes achieved by derating.
6. Starting Torque: 100% starting torque shall be available from 0.5 Hz to 60 Hz.
7. Overload capability: 110% of rated F.L.A. (full load amps) for 60 seconds; 150% of rated F.L.A., instantaneously.
8. The VFD must meet the requirements for Radio Frequency Interface (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.
9. In compliance with IEEE 519, the Total Harmonic Voltage Distortion for the VFD shall be no greater than 5%, the supplier of the VFD shall provide a dc bus choke or line reactors to ensure compliance. In order to estimate THVD the following is needed: Point of Common Coupling (PCC) and the KVA, and secondary voltage of the supply transformer. Assume 5.00% transformer impedance. If no transformer is present assume 50% of service demand.
10. VFDs must have a minimum short circuit rating of 65 Kamps RMS without additional input fusing.

C. Design:

1. VFD shall employ microprocessor based inverter logic, isolated from all power circuits.

2. VFD shall include surface mount technology, with conformal coating.
3. VFD shall employ a PWM (pulse width modulated) inverter system, consisting of:
 - a. Input Section:
 - 1) VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier, with MOV (metal oxide varistor) protection.
 - b. Intermediate Section:
 - 1) DC bus as a supply to the VFD Output Section shall maintain a fixed voltage with filtering and short circuit protection.
 - 2) DC Bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - c. Output Section:
 - 1) Insulated gate bipolar transistors (IGBT's) shall convert DC bus voltage to variable frequency and voltage.
 - 2) PWM sine coded output to the motor.
4. The VFD must be selected for operation at carrier frequencies at or above 5 kHz without derating to satisfy the conditions for current, voltage and horsepower as indicated on the equipment schedule.
5. VFD shall include one independent remote reference input. The input shall be 0 - 10 VDC or 4 – 20mA. Input shall respond to a programmable bias and gain.
6. VFD shall include a minimum of two digital input terminals:
 - a. Reverse rotation direction
 - b. Remote Reset
7. VFD shall provide terminals for remote contacts, to allow starting in the automatic mode.
8. VFD shall include one fully rated form-“A” contact and one fully rated form “C” contact. The contact purpose is selectable and shall provide one of two functions:
 - a. Drive Running
 - b. Drive Faulted
9. VFD shall include a power loss ride of 2 seconds.
10. VFD shall include front mounted control operators that set the motor overheat drive shutdown, set the acceleration and deceleration, and set the output frequency limits. Operating mode (auto or manual) and speed setting functions shall also be provided.
11. VFD shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the VFD enclosure.
12. VFD shall include the following program functions:
 - a. Auto restart capability.
 - b. Stall prevention capability.

- c. Ability to close fault contact after the completion of all fault restart attempts.
- 13. VFD shall include factory settings for all parameters, and the capability for those settings to be reset.
- 14. VFD shall include the capability to adjust the following functions, while the VFD is running:
 - a. Forward/Reverse direction.
 - b. Acceleration adjustment from 0 to 3600 seconds.
 - c. Deceleration adjustment from 0 to 3600 seconds.
 - d. One preset speed.
- 15. All units to be provided with fused disconnect integral to the VFD. Fuse sized for the equipment per NEC.
- D. Product Options:
 - 1. Provide the following:
 - a. RFI (radio frequency interference) filters to attenuate possible VFD generated noise. The addition of these filters should reduce the line conducted noise levels within the limits of FCC regulations, part 15, subpart J, for Class A devices.
 - b. Current limiting input fusing for the protection of VFD semiconductor devices.
 - c. Line reactors reduce the effect of the load and line side transients on the drive. May be used on either the input side or output side of the drive.
 - d. "DC bus reactor", to attenuate harmonic distortion.
 - e. DV/DT Filtering: When inverter duty type motors are not provided, maximum allowed VFD output rise is 1000 volts in 2 microseconds.
- E. Fabrication:
 - 1. Enclosure: NEMA Type 1 unless otherwise specified on drawings.
- F. Source Quality Control:
 - 1. In-circuit testing of all printed circuit boards shall be conducted, to insure the proper mounting and correct value of all components.
 - 2. All printed circuit boards shall be burned in for 96 hours, at 85 degrees C.
 - 3. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All tests results shall be stored as detailed quality assurance data.
 - 4. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.
 - 5. Inspect and production test, under load each completed VFD assembly.
- G. Acceptable Manufacturers:
 - 1. Square D
 - 2. ABB
 - 3. Yaskawa

4. Danfoss

PART 3 - EXECUTION

3.01 NOT APPLICABLE

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – General Mechanical Requirements
 - 2. Section 22 20 00.01 – Excavation & Backfill for Mechanical Underground Utilities
 - 3. Section 23 05 48.01 – Vibration and Seismic Control
 - 4. Section 23 07 19.01 – HVAC Piping Insulations

1.02 GENERAL

- A. Includes:
 - 1. Pipe Hangers and Supports
 - 2. Duct Hangers and Supports
 - 3. Mechanical Equipment Anchors and Supports

1.03 QUALITY ASSURANCE

- A. Pipe Hanger Standards: (MSS) Manufacturers Standardization Society Standards SP-58-2002, SP-89-2003, and SP-69-2003.
- B. All methods, materials, and workmanship shall conform to the International Building Code (IBC) and International Mechanical Code (IMC), as amended and adopted by the authority having jurisdiction.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Hangers.
- B. Struts.
- C. Anchors.
- D. Shop drawings are required for all equipment supports and fabricated supports or assemblies.

1.05 OPERATION AND MAINTENANCE OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Hangers and Supports: Elcen, Grinnell, B-Line Systems, Unistrut, Michigan, Tolco, PHD.
- B. Anchors: Rawplug, Phillips, Hilti, Michigan.

2.02 GENERAL HANGERS AND SUPPORTS

- A. Hanger Rods: Threaded hot rolled steel, electro-galvanized or cadmium plated. Hanger rods shall be sized so that the total load (including pipe or duct, insulation, hangers, and fluid) does not exceed the following:

<u>Nominal Rod Diameter</u>	<u>Maximum Load</u>
3/8 Inch	610 Pounds

1/2 Inch 1130 Pounds

- B. Hanger Straps: Galvanized steel. Straps shall be sized so that the total load does not exceed the following:

<u>Strap Size</u>	<u>Maximum Load</u>
1" x 22 Gauge	230 Pounds
1" x 20 Gauge	290 Pounds
1" x 18 Gauge	380 Pounds
1" x 16 Gauge	630 Pounds

- C. Beam Attachments: Shall be of the following type:

<u>MSS Type</u>	<u>Elcen Figure No.</u>	<u>Grinnel Figure No.</u>
21	33, 34	131
22	67	66
23	29A	87
28	95	292, 228
30	95	229

- D. Anchors: Masonry anchors shall be Phillips wedge anchors, Phillips "Red Head" or Rawl "Saber-Tooth".
- E. Steel: Structural steel per ASTM A36.
- F. Wood: Shall be fire treated.

2.03 PIPE HANGERS AND SUPPORTS

- A. All hangers used directly on copper pipe shall be copper plated or have a factory applied 1/16-inch thick (minimum) plastic coating on all contact surfaces.
- B. All other hangers, supports, and hardware shall be cadmium plated or galvanized.
- C. Fire sprinkler supports shall comply with NFPA-13.
- D. Pipe Hangers and Supports: Shall be of the following type (numbers are 'MSS'):

<u>Maximum System Temperature</u>	<u>Insulated Pipe Type</u>
120 to 450 Degrees	1, 3, 7, 9, 10, 41, 42, 43, 44, 45, 46, E
60 to 120 Degrees	1, 3, 7, 9, 10
33 to 59 Degrees	1, 3, 5, 7, 9, 10, 41, 42, 43, 44, 45, 46, E

- E. Vertical Pipe Supports: MSS Type 8 riser clamp (Elcen Fig. 39 and 339; Grinnel Fig. 261 and 261C).
- F. Trapeze Hangers: Shall be constructed of carbon steel angles, channels, or other structural shapes with flat surface for point of support. Trapeze hangers shall be supported with hanger rods suspended from concrete inserts or approved structural clips. Provide a steel washer plate (Elcen Fig. 84 or equal) where hanger rod nuts bear on trapeze hanger.
- G. Insulated Pipe Supports and Insulation Shields:

1. Insulation material at pipe support shall consist of expanded perlite insert with flame resistant jacket of nylon reinforced kraft paper bonded to aluminum foil cover on insulation, with sheet metal shield. Expanded perlite shall have no more than 5% deformation at 100 psi and a thermal conductivity no more than 0.32 Btu/hr./sq. ft./degree F/1-inch thick.
2. Expanded perlite insert shall be same thickness as adjoining pipe insulation and sized to match pipe in which it is used on. See Section 23 07 19.01 for insulation sizes.
3. Provide shield per Section 23 11 19.01 HVAC Piping Specialties.
4. Manufacturer: Michigan Hanger Company, Model Nos. 1031 and 4031.

2.04 DUCT HANGERS AND SUPPORTS

- A. Hangers: As shown in SMACNA HVAC Duct Construction Standards.
- B. Vertical Duct Supports at Floor: 1-1/2" x 1-1/2" x 1/8" (minimum) galvanized steel angle and to support ducts, as shown in SMACNA HVAC Duct Construction Standards Figure 4-6. For ducts over 30 inches wide, provide riser reinforcing with hanger rods between the riser support and riser reinforcing.
- C. Vertical Duct Supports at Wall: 1-1/2" x 1/8" (minimum) strap or 1-1/2" x 1-1/2" x 1/8" (minimum) angle bracket and as shown in SMACNA HVAC Duct Construction Standards Figure 4-7.
- D. Hanger Attachments to Structure: As shown in SMACNA HVAC Duct Construction Standard Figures 4-1, 4-2, 4-3 to suit building construction and as allowed on structural drawings. Where C-clamps are provided, retainer clips shall be used. Friction beam clamps shall not be used.
- E. Hanger Attachments to Ducts: As shown in SMACNA HVAC Duct Construction Standards Figure 4-4.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

- A. Provide all necessary bolts, nuts, washers, turnbuckles, rod connectors, and any other miscellaneous accessories required for the support and anchoring of all pipes, ducts, and mechanical equipment.
- B. Install steel or wood backing in walls (anchored to studs) as required to provide support for items hung from walls.
- C. Install concrete inserts and anchors in accordance with manufacturer's instructions.
- D. All welded steel support assemblies shall have a power wire brush and primer paint finish.
- E. Maximum spans between piping supports may be significantly less than the maximum spans allowed herein due to structural limitations of allowable loads on hangers. The most restrictive criteria governs. Reference structural drawings.

3.02 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- A. Pipe which is not run underground, shall be adequately anchored to the structure to prevent sagging and to keep pipe in alignment.
- B. All pipe supports shall be provided with a means of adjustment for the aligning and leveling of the pipe after installation.

- C. Installation and sizing of pipe supports and accessories shall be in accordance with the manufacturer's recommendations and standard MSS SP-89 and MSS SP-69, NFPA #13 for fire protection piping, UPC, and IMC.
- D. Provide supports at each change in direction of piping.
- E. Where mechanically coupled piping is used, a hanger shall be placed within 2 feet on each side of couplings, with hanger spacing in no case to exceed the following:

Nominal Pipe Diameter	Maximum Span Mechanically Coupled Piping
3/4 to 1 Inch	7 Feet
1 ¼ to 1 ½ Inch	7 Feet
2 Inches	10 Feet
2 ½ Inches	10 Feet
3 Inches and Larger	12 Feet

NOTE: Manufacturer's support instructions shall be used where it is more restrictive than the above. Above is for rigid coupled piping systems. Follow manufacturer's requirements for flexible piping systems, except that in no case is spacing to be more than the above.

- F. Steel Pipe: Maximum spacing between supports:

Nominal Pipe Diameter	Maximum Span Steel Pipe
1/2 Inch	6 Feet
3/4 to 1 Inch	8 Feet
1 ¼ to 2 ½ Inch	10 Feet
3 Inches and Larger	12 Feet

- G. Copper Tubing: Maximum spacing between supports:

Nominal Tubing Diameter	Maximum Span Copper
1/2 Inch	5 Feet
3/4 to 1 ¼ Inch	6 Feet
1 ½ to 2 ½ Inch	8 Feet
3 Inches and Larger	10 Feet

- H. Vertical Piping Supports: Support piping at each floor line with pipe clamps and at intermediate points as required to prevent excessive pipe movement and so as to comply with the maximum spacings cited above. Support all pipe stacks at their bases with a concrete pier or suitable hanger. For vertical pipe drops which occur away from a wall or similar anchoring surface, provide angled bracing from nearest structure to provide rigid anchoring of pipe drop.
- I. Insulated Pipe Supports and Insulation Shields: Protect insulated pipe at point of support with pipe insert and shield as required by the following table:

Nominal Pipe Diameter in Inches	Insulation Length in Inches	Shield Length in Inches	Minimum Shield Gauge

½ to 2	6	6	20
2 ½ to 3 ½	6	6	18
4 to 5	9	8	18
6 to 10	9	8	16

Such supports shall be in place at the time of installing pipe.

- J. Underground Pipe: Shall be evenly supported on approved bedding materials, as specified for the type of piping being used. Such bedding and backfilling shall be as specified in Section 22 00.01.

3.03 INSTALLATION OF DUCT HANGERS AND SUPPORTS

- A. Provide anchors and supports for all ductwork.
- B. Rectangular Duct: Supports and hangers shall be of size and spacing as shown in SMACNA HVAC Duct Construction Standards for the appropriate class of duct. (Hangers maximum allowable loads shall not be as shown in SMACNA Tables but shall be as specified in these specifications.)
- C. Round Duct: Supports and hangers shall be of size and spacing as shown in SMACNA HVAC Duct Construction Standards for the appropriate class of duct.
- D. Maximum Hanger Spacing (provided duct gauge and reinforcement comply with SMACNA Standards for such spacing):

Duct Area	Maximum Spacing
Up to 4 sq. ft. (27" Diameter)	8 Feet
4.1 to 10 sq. ft. (28" to 42" Diameter)	6 Feet
10.1 sq. ft. and up (43" Diameter and up)	4 Feet

- E. Provide supports at each change in direction of duct. Locate hangers at inside and outside corners of elbows, or at each end of fitting, on each side.
- F. Provide additional supports at each side concentrated loads (such as modulating dampers, duct heaters, sound attenuators, etc.)
- G. Provide supports for exterior ductwork per SMACNA HVAC Duct Construction Standards or as detailed on the drawings.

3.04 CEILING AIR TERMINALS/SERVICES

- A. Ceiling mounted air terminals or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
- B. Terminals or services weighing 20 pounds but not more than 56 pounds in addition to the above shall have two No. 12 gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.
- C. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.
- D. All air terminals that use side inlet "plenums" or have fire dampers shall be supported directly from the structure with approved hangers (regardless of total weight).

3.05 INSTALLATION OF MECHANICAL EQUIPMENT ANCHORS AND SUPPORTS

- A. Provide anchoring and supports for all mechanical equipment.
- B. Heating, Ventilating and Air Conditioning equipment where suspended from structure shall be supported per SMACNA HVAC Duct Construction Standards or as shown on the drawings.
- C. Roof mounted equipment shall be installed on roof curbs provided with the equipment (unless indicated otherwise). Such equipment shall be anchored to the curb, with the curb anchored to the building structure.
- D. Equipment shall be supported and anchored in such a way so that no equipment vibration is transmitted to the building structure.
- E. Added supports and bracing shall be provided per Section 23 05 48.01.
- F. Provide curbing as shown on drawings and as required to support all mechanical equipment.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 20 00 00.01 – “General Mechanical Requirements”

1.02 GENERAL REQUIREMENTS

- A. This section includes, but not limited to vibration isolation and seismic restraint installation for all equipment, ductwork, and piping as described here-in.
- B. Seismic Restraints shall be bidder-designed. Seismic Design Criteria are to be established per the International Building Code and ASCE 7-05 along with Project Structural drawings.
- C. Items not included in this specification shall not relieve the contractor of the responsibility of providing seismic bracing that meets all the criteria required by the referenced codes and in accordance with the seismic design guidelines and the project structural drawings.

1.03 REFERENCED CODE AND STANDARDS

- A. The latest adopted versions of the following codes and standards apply to this section.
 - 1. International Building Code (IBC)
 - 2. National Fire Protection Association (NFPA-13)
 - 3. Seismic Restraint Manual – Guidelines for Mechanical Systems (SMACNA)
 - 4. ASCE 7-05, American Society of Civil Engineers “Minimum Design Loads for Buildings and Other Structures”
 - 5. Applicable Project Structural Drawings for Seismic Design Criteria
 - 6. Applicable Manufacturer’s Seismic Design Guides for proprietary listed seismic bracing and mounting hardware
 - 7. Where there is a conflict in requirements between these guidelines and above mentioned codes the more stringent parameters shall prevail.

1.04 DESIGN CRITERIA

- A. Occupancy Category of Structure (I-IV) per IBC or ASCE 7-05
- B. Component Importance Factor (I_p) per ASCE 7-05
- C. Mapped Acceleration Parameters (S_1 and (S_s) per IBC and Project Structural Drawings
- D. Site Class (A – F) per IBC and Project Structural Drawings
- E. Site Coefficient (F_a) per IBC and Project Structural Drawings
- F. Site Coefficient (F_v) per IBC and Project Structural Drawings
- G. Seismic Design Category (A – D) based on Short Period Response Accelerations per IBC and Project Structural Drawings
- H. Seismic Design Category (A – D) based on 1-Second Period Response Acceleration per IBC and Project Structural Drawings
- I. Amplification Factor a_p per ASCE 7-05

J. Response Modification Factor R_p per ASCE 7-05

1.05 SUBMITTAL REQUIREMENTS

A. Isolation Pads

B. Spring Isolators

C. Seismic Control:

1. Periodic Special Inspections: The contractor shall provide a list of components/systems requiring periodic special inspections per IBC.
2. Special Certification Requirements: Each contractor responsible for the construction of a "Designated Seismic System" for active mechanical equipment that must remain operable following the design earthquake, or components with hazardous contents certified by the manufacturer to maintain containment following the design earthquake shall submit a Manufacturer's Certificate of Compliance for review and approval by the Registered Design Professional responsible for the design of the system. This information shall then be submitted to the Authority Having Jurisdiction.
3. All brace or restraint components, mounting devices, snubbers and anchors.

1.06 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Not Applicable

2.02 NEOPRENE ISOLATORS

- A. Isolation Pads: Oil resistant neoprene pads, minimum 1/4-inch thick, with cross-ribbed or waffle design. Size pads for not more than 50 psi or as recommended by vibration isolator manufacturer.
- B. Floor Mounted Isolators: Double deflection type neoprene mounts, having minimum deflection of 0.35 inch. All metal surfaces shall be neoprene covered, base plate shall have mounting holes, and top shall have threaded steel plate or threaded steel insert. Element shall be color coded or labeled with molded symbols to identify capacity. Mason Series ND, Amber Booth "RV" or approved.
- C. Suspension Isolators: Shall be double deflection neoprene type, with isolator encased in open steel bracket and minimum 3/8-inch deflection. Hanger rod shall be isolated from steel bracket with neoprene grommets. Mason Series HD, Amber Booth "BRD" or approved.

2.03 SPRING ISOLATORS

- A. General: The load carried by each isolator shall be carefully calculated and isolators selected so that the static deflection will be the same and the supported equipment will remain level. Isolators shall be so designed that the ends of the springs will remain parallel during and after deflection to operating height. At operating height, springs shall have additional travel to complete (solid) compression equal to at least 50 percent of the operating deflection. Suspension isolator springs shall have a static deflection (as shown on drawings) not less than 1-1/2", except that for units with components rotating at 1000 rpm and less, the static deflection shall be not less than 2 inches. Floor isolator springs shall have deflection of not less than 1 inch. All isolators shall provide at least 96% isolation efficiency. Note: Deflections other than

these may be used where circumstances warrant and more optimum isolation results can be achieved.

- B. Floor Type Spring Isolators: Shall be open spring type with approximate ratio between horizontal and vertical spring constant of 1.0. A ribbed neoprene acoustical friction pad shall be bonded to the underside of the isolator. Provide with height saving bracket. Mason Series SLF, Amber Booth "SW" or approved.
- C. Floor Housed Type: Housed spring isolator with ductile iron housing, steel base plate with mounting holes, spring inspection ports, neoprene cushion, leveling screws. Mason Series SSLFH, Amber Booth "XLS" or approved.
- D. Suspension Type Spring Isolators: Shall consist of a rigid steel frame, a stable steel spring in the bottom part of the frame, and double deflection neoprene isolating pad at the top of the frame. Where supporting rods pass through the frame, a clearance of not less than one half rod diameter shall be provided all around the rod. Mason Series DNHS, Amber Booth "BSSR" or approved.

2.04 SEISMIC RESTRAINTS

- A. General:
 - 1. All seismic hangers and components shall be domestically made. Products designed domestically and fabricated in a foreign country are prohibited.
 - 2. Products not permitted include: powder actuated anchors, gas actuated anchors, or anchors requiring epoxy.
 - 3. Only Steel or Ductile Iron components shall be provided. No Cast Iron or Cast Aluminum components are allowed.
 - 4. Steel shall be per ASTM A36; hangers and other devices shall be as shown in "SMACNA Seismic Restraint Manual" or approved manufacturers seismic design guidelines.
- B. Seismic Bracing (rigid and cable):
 - 1. Approved Manufacturers:
 - a. Tolco
 - b. International Seismic Application Technology (ISAT)
 - c. Mason Industries
 - d. Cooper B-Line
 - e. Kinetics Noise Control
 - f. AFCON
 - g. Gripple
 - h. PHD
 - i. Unistrut
 - j. Anvil or prior approved equal.
- C. Seismic Anchorages (for wood, steel and concrete):
 - 1. Approved Manufacturers:
 - a. Hilti

- b. ITW Ramset/Red Head
 - c. ITW Buildex
 - d. Mason Industries
 - e. Tolco, AFCON
 - f. Simpson Strong-Tie
 - g. Powers Fasteners, Inc. or prior approved equal.
- D. Flexible Connectors:
 - 1. Approved Manufacturers:
 - a. Mason Industries
 - b. Metraflex
 - c. Victaulic
 - d. Kinetics Noise
 - e. International Seismic Application Technology (ISAT) or prior approved equal.
- E. Pipe Hanger Components:
 - 1. Approved Manufacturers:
 - a. Tolco
 - b. International Seismic Application Technology (ISAT)
 - c. Mason Industries
 - d. Cooper B-Line
 - e. Kinetics Noise Control
 - f. AFCON
 - g. Gripple
 - h. PHD
 - i. Unistrut
 - j. Anvil or prior approved equal

PART 3 - EXECUTION

3.01 VIBRATION ISOLATION

- A. Motorized equipment shall be mounted on or suspended from spring vibration isolators either integral or external to the equipment. Floor mounted or suspended isolators.
- B. Unless otherwise indicated, resilient mounts for motorized equipment shall be of the type and size to provide maximum ten percent transmissibility. Use unhoused, free-standing stable steel springs which are preferred over housed spring assemblies. The horizontal stiffness of the spring shall be approximately equal to its vertical stiffness. The Spring deflection shall be selected based on the equipment power range (HP), speed range (RPM), and static deflection of the supporting structural floor. For large equipment such as fans the steel spring static deflection of the supporting structural floor. It is a specific recommendation that whenever a

steel spring is used, two pads of ribbed waffle-pattern neoprene be used in series with the spring.

- C. The design of vibration dampening shall consider lateral load as well as vertical load and be suitably snubbed against earthquake forces.
- D. A list of isolators accompanied by certified transmissibility ratings for the required duty shall be submitted for each item of equipment.
- E. Unless noted otherwise, all vibration isolating equipment shall be of the same make and shall be submitted as one group.
- F. All piping in the mechanical equipment rooms connected to vibrating equipment shall be supported from resilient ceiling hangers or from floor mounted resilient supports.
- G. Special equipment, such as compressors, condensation pumps, etc., shall be selected on an individual basis.
- H. Inertia bases shall be provided for all equipment with rotating or reciprocating parts when such equipment is located above occupied spaces and for equipment where the motor is separate from equipment. Bases shall be constructed of welded steel angles and channel frame filled solid with structural concrete with #4 rebar at 6 inches on center spanning short dimensions.

3.02 SEISMIC BRACING GENERAL REQUIREMENTS

- A. Support and bracing from the structure to pipes, ducts and mechanical equipment shall conform to the plumbing & HVAC industry standard SMACNA "Seismic Restraint Manual, Guidelines for Mechanical Systems" or approved manufacturer's listed seismic assemblies.
- B. Provide snubbers for all equipment that is supported on isolators and weighing over 400 lbs. including base. Provide minimum of four snubbers for equipment weighing less than 2,000 lbs., and eight snubbers for heavier equipment.
- C. Curb-mounted rooftop units shall be provided with suitable bracing on four sides connecting unit with curb to prevent excessive movement in a seismic event. The contractor is responsible for proper seismic attachment of the rooftop curb to building structure.
- D. Provide seismic bracing for hot water tanks.
- E. Housekeeping pads shall be properly anchored to the roof deck or floor per ASCE 7-05.

3.03 SEISMIC BRACING GENERAL REQUIREMENTS - PIPING

- A. When determining horizontal load requirements, consider all pipes full of water and maximum equipment heights unless unless calculated for other substances and equipment.
- B. Seismic bracing shall not limit the expansion and contraction of the piping system. When thermal expansion or contraction is involved, longitudinal bracing shall be designed at the anchor point of the piping system. The longitudinal bracing and the connections much be capable of resisting the additional force induced by expansion and contraction.
- C. Seismic bracing for fire sprinkler system piping and riser components shall be as specified per NFPA-13.

3.04 INSTALLATION

- A. Installation of seismic restraints shall be as follows:
 - 1. Upon completion of installation of all seismic restraint materials and before start up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.

2. All external utility connections to restrained equipment shall be designed to allow differential seismic motion without damage to the equipment or utility connections.
3. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following manufacturer's written instructions.
4. After equipment installation is completed, adjust limit stops following manufacturer's written instructions so they are out of contact during normal operation.
5. Adjust snubbers according to manufacturer's written instructions.
6. Torque anchor bolts according to anchor manufacturer's written instructions to resist seismic forces.
7. Attach piping to the trapeze per seismic restraint manufacturer's design. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
8. Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to rods.
9. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer to seismic restraint manufacturer's written instructions

3.05 SPECIAL INSPECTIONS

- A. When required continuous or periodic special inspections of the equipment and systems designated on the list provided by the mechanical contractor shall be performed in accordance with the IBC and ASCE 7-05. The Port shall reserve the right to employ an approved special inspector.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 STANDARDS

- A. ANSI Compliance: Comply with ANSI A13.1 for lettering size, colors, and installed viewing angles of identification devices.

1.03 SCHEDULES

- A. Submit Valve Schedule for each piping system, typewritten, and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. Provide a framed copy of Valve Tag Schedule in the mechanical/janitors room.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 PLASTIC PIPE MARKERS

- A. Provide manufacturer's standard preprinted, flexible or semi-rigid, permanent, color-coded, plastic sheet pipe markers.
 - 1. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125° F (52° C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
 - 2. Small Pipes: For external diameters less than 6" (including insulation if any), provide full band pipe markers, extending 360° around pipe and minimum 12" long at each location, fastened by one of the following methods:
 - a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - b. Adhesive lap joint in pipe marker overlap. Laminate or bonded application of pipe marker to pipe (or insulation).
 - c. Strapped to pipe with nylon strap.
 - 3. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Engineer in cases of variance with names as shown or specified.
 - a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.03 PLASTIC TAPE

- A. Manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

1. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6".

2.04 PLASTIC VALVE TAGS

- A. Provide manufacturer's standard plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.

2.05 VALVE TAG FASTENERS

- A. Manufacturer's standard solid brass (wire link or beaded type), or solid brass S-hooks of sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.06 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. Provide engraved stock phenolic plastic laminate, complying with FS L-P-387, engraved with engraver's standard letter style of sizes and wording, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
 1. Thickness: 1/16" for units up to 20 sq in or 8" length; 1/8" for larger units.
 2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.
 3. Letter Size: No less than 1/2" tall. (Use unit# as noted on the equipment schedules)
- B. Provide for all items on equipment schedules.
- C. Provide for all emergency shut-offs.
- D. Provide for all pressure vessels, storage tanks, air separators, etc.

2.07 PAINT

- A. Benjamin Moore Impervo or equivalent.
- B. Use appropriate primer.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING IDENTIFICATION

- A. Install pipe markers on each system, and include arrows to show normal direction of flow.

3.03 PIPE MARKERS AND COLOR BANDS

- A. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied space, machine rooms, accessible maintenance spaces and exterior non-concealed locations or in accessible ceiling spaces.
 1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floor/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes, and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings omit intermediately spaced markers.
8. Color assignments and stencil for piping identification shall be as listed below (colors used shall be verified with Engineer prior to ordering).

<u>Service</u>	<u>Color</u>	<u>Stencil</u>
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Refrigerant Liquid	Yellow	White
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Sprinkler Work	Red	White
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Condensate Piping	Green	White
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9. Identification stenciling and flow arrows shall be following colors for proper contrast:

<u>Arrows & ID Stenciling</u>	<u>Color Shade of Pipe</u>
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White	Red, Gray, Black and Green
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Black	Yellows, Oranges and White
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3.04 VALVE IDENTIFICATION

- A. Provide valve tag on every valve, cock, and control devices in each piping system; exclude check valves, valves within factory-fabricated equipment units, convenience and lawn watering hose bibbs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in Valve Schedule for each piping system.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operation device. Provide signs for the following general categories of equipment and operational devices. Provide signs on suspended ceiling tile below mechanical equipment located above ceiling.
 1. Pumps and similar motor-driven units.
 2. Fans, exhaust, and air handling units.
 3. Tanks and pressure vessels.

3.06 FIRE AND FIRE/SMOKE DAMPER IDENTIFICATION

- A. Furnish and install label reading "FIRE DAMPER" or "FIRE/SMOKE DAMPER" on each fire damper duct access door. Provide additional labels at locations where external duct insulation covers the access door. Install on outside of insulation.

3.07 CONCEALED ITEMS

- A. Items concealed above accessible ceilings requiring access, shall have the ceiling marked to indicate such items location. The marking system shall consist of colored phenolic plates with

½" tall engraved lettering specifying the item concealed; plate shall be applied to ceiling T-bar framing with rivets or other Engineer approved method below the concealed item. Colors used shall be verified with Engineer, and unless directed otherwise, shall be:

<u>ITEM</u>	<u>COLOR</u>
Heating System Equipment Component	Green
Fire Protection System Component	Red

- B. Provide three (3) color legends (hard laminate) listing the above colors. Locate as directed by the Engineer.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Division 23 – “Heating Ventilating and Air Conditioning” shall make changes in pulley, belts, and dampers as required for correct balance as recommended by Air Testing & Balancing Agency at no additional cost to Port.
 - 2. Division 23 – “Heating Ventilating and Air Conditioning” shall repair leaks in ductwork at no additional cost to Port.

1.02 GENERAL

- A. Includes, but not limited to, testing, balancing and adjusting of air heating, cooling and exhaust systems.

1.03 SYSTEM DESCRIPTION (PERFORMANCE REQUIREMENTS)

- A. Perform testing and balancing in complete accordance with the Associated Air Balancing Council (AABC), National Environmental Balancing Bureau (NEBB), or National Balancing Council (NBC) standards and procedures.
- B. Air Testing & Balance Agency shall perform tests specified, compile test data, and submit copies of complete test data to Contractor for forwarding to Engineer for evaluation and approval.

1.04 SUBMITTALS REQUIRED BY THIS SECTION

- A. Company information including Washington State Contractors' license.
- B. Key personnel and resumes.
- C. AABC, NEBB, or NBC certifications.
- D. Provide reference of five (5) completed jobs of similar size and complexity.

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Final air balance report shall be bound in the O & M Manual or provided under a separate volume.
- B. Preliminary air balance report shall be submitted to the Engineer for approval. Preliminary report shall note all finished measured data.
- C. Final Test Data:
 - 1. Provide project name, name and telephone number of balancing firm, GC, MC, Architect, and Engineer in the cover (or first page) of report.
 - 2. Provide a summary of air balance findings regarding airtightness of each ducted systems, deficiencies of equipment to meet design requirements, deficiencies of space pressure relationships, etc.
 - 3. Cover sheet shall have a statement from the site project manager that reads, “The air system testing and balancing report contained here in is true and factual based on actual field measurements and adjustments. I have personally performed or witnessed a minimum of 5% of the airflow tests.”
 - 4. Each page of test report to have a unique page number.

5. Provide fan curve or chart of each fan in system.
6. Provide final approved test report in PDF format on CD. Provide one more CD than hard copies of test report.

1.06 QUALITY ASSURANCE (QUALIFICATIONS)

- A. Contractor shall procure services of an independent Air Testing & Balance Agency, which specializes in testing, and balancing of heating, ventilating, and cooling systems to balance, adjust, test air-moving equipment, air distribution, and exhaust systems.
- B. Agency shall be approved in writing by Engineer.
- C. Instruments used by Agency shall be accurately calibrated and maintained good working order.
- D. If requested, conduct tests in presence of Engineer.

1.07 SEQUENCING & SCHEDULING

- A. Contractor shall award test and balance contract to approved agency upon receipt of his contract to proceed to allow Agency to schedule this work in cooperation with other Sections involved and comply with completion date.
- B. Begin air testing and balancing upon completion of air cooling, heating, and exhaust systems including installation of all specialties and devices.
- C. Contractor shall put heating, ventilating, and cooling systems and equipment into full operation and continue their operation during each working day of testing and balancing.

PART 2 - PRODUCT

2.01 NOT APPLICABLE

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Testing Procedure: Air Testing & Balancing Agency shall perform following tests and balance system in accordance with following requirements at design conditions of supply and a minimum outside air CFM (not 100% return or 100% economizer).
 1. Test, adjust, and record fan rpm to design requirements.
 2. Test and record motor amperes at design conditions.
 3. Make pitot tube traverse of main supply duct and obtain design cfm at fans. (systems of 1000 CFM or greater)
 4. Test and record system static pressures: suction, discharge, and clean filters (if applicable; for systems of 2000 CFM or greater)
 5. Test, adjust, and record system for design cfm air.
 6. Test, adjust, and record system for design cfm outside air.
 7. Test, adjust, and record each diffuser, grille, and register to within 10% of design requirements.
 8. On a floor plan, identify each diffuser, grille, and register to location and area using a designation symbol unique to that page.
 9. Identify and list size, type, and manufacturer of diffusers, grilles, registers, and testing equipment. Use manufacturer's rating on equipment to make required calculations.

10. In readings and tests of diffusers, grilles, and registers, include required cfm and test cfm after adjustments.
11. In cooperation with Division 23, set adjustments of automatically operated dampers to operate as specified, indicated, or noted.
12. Adjust diffusers, grilles, and registers to minimize drafts.
13. Identify at each volume damper with permanent mark, the position of actuator handle once final balance has been achieved.
14. Measure and record all pressure differential relationships as identified by the controls diagrams (i.e. kitchen, building pressure, etc). These measurements are to be taken when all HVAC is running after full balance has been completed. Note the measured reference points to determine the pressure differential.
15. For any spaces with exhaust and supply to them where design airflows cannot be obtained, the systems shall be adjusted to produce a negative pressure to the adjacent space (i.e. workrooms, restrooms, etc.)
16. When reconciling supply, return, outside, and exhaust air quantities, priority shall be placed on outside air quantities (typically, return air quantities noted on plans are for duct sizing only).
17. Verify that all gravity backdraft dampers are moving freely, open in proper direction, and are unbound.
18. After balancing system, measure terminal CFM when system is in 100% economizer. If supply is greater than design, coordinate controls with contractor to provide damper stops to provide design CFM during 100% economizer.

B. Final Inspection & Adjustments:

1. Balancing agency shall be represented at final inspection meeting by qualified testing personnel with balancing equipment and two copies of air balancing test report.
 - a. Engineer may choose and direct spot balancing of one zone. Differences between the spot balance and test report will be justification for requiring repeat of testing and balancing for entire building.
 - b. Rebalancing shall be done in presence of Engineer and subject to his approval.
 - c. Spot balance and rebalance shall be performed at no additional cost to the Port.
2. System shall be completely balanced and all reports submitted to Engineer prior to prefinal inspection.
3. Where equipment supplied to job site provides over 5% more air than schedule requirements, rooms supplied by that equipment shall have their supply air quantities increased by the ratio of actual total air quantity supplied to minimum air quantity required by schedule.

3.02 BALANCING FIRMS (APPROVED)

- A. Hardin and Sons
- B. Testing and Commissioning Services
- C. MTW Design Services
- D. Airtest Company, Inc.

- E. American Air Balance Company
- F. Advanced Mechanical Services, Inc.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Conditions”
 - 2. Section 23 31 13.01 – “Steel Ductwork”

1.02 GENERAL

- A. This section describes the insulation requirement to meet or exceed the 2012 Washington State Energy Code. Lining installation is per Section 23 31 13.01.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Wrap Insulation

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 DUCTWORK INSULATION

- A. Manufacturers: Manville Corporation Owens Corning, Knauf Insulation or approved equal.
- B. Flexible Fiber Glass Blanket (Wrap Insulation): Manville, Microlite Type 75 meeting ASTM C553, Type 1, Class B-2; flexible blanket.
 - 1. 'K' ('ksi') Value: 0.27 at 75°F (0.040 at 24°C) installed.
 - 2. Density and R-value:
 - a. R-3.3: 1.0" inch of 1.5 to 3.0 lb/cu. Ft. glass fiber blanket.
 - b. R-5.3: 2.0" inches of 0.75 lb/cu. Ft. or 1.5 inches of 1.5 to 3.0 lb/cu. Ft. glass fiber blanket.
 - c. R-7: 3.0 inches of 0.75 lb/cu. Ft. or 2.0 inches of 1.5 to 3.0 lb/cu. Ft. glass fiber blanket.
 - 3. Vapor Barrier Jacket: FSK, aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward cinched expanded staples and vapor barrier mastic as needed.
- C. Rigid Fiber Glass Board: Insulation Board meeting ASTM C 612 Type IA and IB; rigid.
 - 1. 'K' ('ksi') Value: ASTM C 177, 0.22 at 75°F mean temperature.
 - 2. Maximum Service Temperature: 450°F.
 - 3. Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or PSK conforming to ASTM C 1136 Type II.
 - 4. Securement: Secured in place using adhesive and mechanical fasteners spaced a minimum of 12" on center with a minimum of 2 rows per side of duct. Insulation shall be

secured with speed washers and all joints, breaks and punctures sealed with appropriate pressure-sensitive foil tape, or glass fabric and vapor retarder mastic.

5. Density and R-value:
 - a. R-4.5: 1.0" of 6.0 B/cu.ft.
 - b. R-6.8: 1.5" of 6.0 B/cu.ft.
 - c. R-9.1: 2.0" of 6.0 lb./cu.ft.

D. Duct Insulation Protection:

1. Aluminum Jacket: 0.016 inch (.045 mm) thick sheet, smooth/embossed finish, with longitudinal slip joints and 2-inch (50 mm) laps.
2. Manville Insulkote ET, a non water-vapor retarder, non-burning, weatherproof coating for use over insulation where "breathing" is required.
3. Manville Zeston 2000 jacketing, UV resistant polyvinyl chloride covering with joints secured and sealed with Manville Perma-Weld Adhesive.
4. Canvas Jacket: UL listed fabric, 6 oz/sq. yd. (220 g/sq. m.), plain weave cotton treated with dilute fire retardant lagging adhesive.
5. Self-Adhering Jacketing: Material to be VentureClad [1579CW] with a white finish. Jacketing material is to have a maximum flame spread/smoke developed index of 25/20 per UL 723, 1 0.0000 water vapor permeance rating per ASTM E-96, mold inhibitors incorporated, and be UV stable.

2.03 DUCTWORK LINING

- A. See Section 23 31 13.01 - Steel Ductwork.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Verify that ductwork has been tested for leakage in accordance with SMACNA standards before applying insulation materials.
- B. Verify that all surfaces are clean, dry, and free of foreign material.
- C. External Ductwork Insulation:
 1. Provide insulated ductwork conveying air below ambient temperature with vapor retardant jacket. Seal all vapor retardant jacket seams and penetrations with UL listed tapes or vapor retardant adhesive.
 2. Provide insulated ductwork conveying air above ambient temperature with or without vapor retardant jacket. Where service access is required, bevel and seal ends of insulation.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations except where prohibited by code.
 4. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.
 5. For ductwork exposed to physical abuse in unfinished and exposed spaces, finish with duct insulation protection.

D. For installation of lining insulation, see Section 23 31 13.01.

3.02 INSULATION SCHEDULE

- A. Provide wrap insulation and duct liner for the duct systems indicated per the following table (R-value indicates the thickness to be provided as defined in Section 23 07 13.01 for wrap insulation and Section 23 31 13.01 for liner):

DUCT TYPE AND LOCATION	LINER	WRAP
<i>Within Conditioned Space:</i>		
- Supply Air	R - 3.3	Not Required
- Return Air	R - 3.3	Not Required
- Relief Air	Not Required	R – 3.3 (See footnote 2)
- Transfer Air	R - 3.3	Not Required
- Exhaust Air	R - 3.3	Not Required (See footnote 2)

Table Footnotes:

- 1 Where duct is exposed to view, provide wrap with paintable duct insulation protection.
 - 2 Building level insulation is required from backdraft/motorized damper to louver or roof hood. See plans for additional details. Coordinate with GC for insulation.
 - 3 Use liner or rigid fiberglass board.
- B. For purposes of the Insulation Schedule above, the following defines the duct systems:
1. Supply Air: Air that has passed through mechanical conditioning device, such as a furnace, coil, evaporative section, heat recovery device, etc. that is distributed to the conditioned space.
 2. Return Air: Air from the conditioned space to an air handler.
 3. Relief Air: Air from the conditioned space to the outdoors or to a large semi-conditioned or non-conditioned space.
 4. Transfer Air: Air from one conditioned space to another conditioned space.
 5. Exhaust air: Air from a space moved by a fan to directly outside. Also, air downstream of a heat recovery device to directly outside.
 6. Outside Air: Air from the outside to a mechanical conditioning device such as a furnace, coil, evaporative section, heat recovery device, etc.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 23 05 29.01 – “Hangers and Supports for HVAC Piping & Equipment”

1.02 GENERAL

- A. Includes, but not limited to, insulating of piping and fittings per schedule in Part 3 of this specification.
- B. Insulation at Hangers: Insulation shall be continuous through hangers on all insulated systems. Inserts at hangers are specified in Section 23 05 29.01 and are considered as part of the hanger and support system. Inserts are required to be installed at the time of pipe installation and are intended to be installed by the Contractor installing the pipe hangers/supports. See Section 23 05 29.01.
- C. The intent of this section is to meet or exceed the requirements of the most current version of the Washington State Energy Code (WSEC). The stricter of this section and WSEC shall be met.

1.03 SECTION INCLUDES

- A. Piping insulation, jackets, and accessories.
- B. Engine exhaust insulation.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. All insulation
- B. Field Applied Jackets

1.05 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 PIPE INSULATIONS

- A. Glass Fiber: Meeting ASTM C547; rigid molded, noncombustible.
 - 1. 'K' ('ksi') Value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Vapor Retarder Jacket: AP-T PLUS White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.
 - 4. Approved Manufacturer:
 - a. Manville

- b. Armstrong
 - c. Knauf
- B. Elastomeric Insulation: Meeting ASTM C534; flexible, closed cell, cellular elastomeric, molded or sheet.
 - 1. Thermal Conductivity: 0.25 Btu-in/hr. Ft² °F.
 - 2. Maximum Service Temperature of -70 degrees F. (-40 degrees C) to 220 degrees F (104 degrees C)
 - 3. Maximum Flame Spread: 25.
 - 4. Maximum Smoke Developed: 25/50 through 1" wall.
 - 5. Maximum water vapor permeability, wet cup, perm-in .10.
 - 6. Connection: Waterproof vapor retarder adhesive as needed.
 - 7. UV-Protection: Outdoor protective coating.
 - 8. Shall have R-Value of 4.2 at 1" and R=8 at 2".
 - 9. The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and WVT.
 - 10. Shall be fiber free, formaldehyde-free, and low VOC's.
 - 11. Approved Manufacturers:
 - a. Armacell
 - b. Kflex
 - c. Aeroflex
- C. Field Applied Jackets:
 - 1. PVC Plastic: One piece molded type fitting covers and jacketing material, gloss white.
 - a. Connections: Tacks; Pressure sensitive color matching vinyl tape.
 - 2. Canvas Jacket: UL listed fabric, 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
 - 3. Aluminum Jacket: 0.016 inch (0.045 mm) thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch (50 mm) laps, die shaped fitting covers with factory attached protective liner.
 - 4. Approved Manufacturer: Manville Zeston 2000.
- D. Approved Manufacturers (Cellular Glass Excluded):
 - 1. Manville
 - 2. Armstrong
 - 3. Knauf
 - 4. Owens Corning
 - 5. IMCOA (for Flexible Unicellular Polyolefin only)

2.03 PIPE SHIELDS (SADDLES)

- A. Saddles shall be minimum, 20 gauge dimpled galvanized sheet steel covering 40% of the circumference of the insulation. Length shall be a minimum of 6". See Section 22 05 29.01 Hangers and Supports for longer shields.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Verify that piping has been tested for leakage in accordance with IMC standards before applying insulation materials.
- B. Verify that all surfaces are clean, dry, and free of foreign material.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's recommendations, building codes, and industry standards.
- B. Continue insulating vapor barrier through penetrations except where prohibited by code.
- C. Piping Insulation:
 - 1. Locate insulation and cover seams in least visible locations.
 - 2. Neatly finish insulation at supports, protrusions, and interruptions.
 - 3. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jacket with self sealing laps. Insulate complete system.
 - 4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions.
 - 5. Insulated pipe supports and insulation shield shall be in place at each hanger and support as required by Section 23 05 29.01 prior to insulating.
 - 6. For pipe exposed in mechanical equipment rooms or exposed in finished spaces up to 10 feet above finished floor, finish with Manville Zeston 2000 PVC jacket and fitting covers or aluminum jacket.
 - 7. Refrigeration Piping:
 - a. Install insulation in snug contact with pipe and in accordance with manufacturer's recommendations.
 - b. Stagger joints on layered insulation.
 - c. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
 - d. Seal joints in insulation.
 - e. Insulate flexible pipe connectors.
 - f. Insulation exposed outside building shall have "slit" joint seams placed on bottom of pipe and given two coats of gray adhesive finish.
 - g. Insulate fittings with sheet insulation and as recommended by manufacturer.

3.03 PIPING INSULATION SCHEDULE

INSULATION TYPE	PIPE SIZE INCH	THICKNESS INCH
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GLASS FIBER INSULATION:

Piping Exposed to Freezing or Semi-Heated Spaces All Sizes 1½"

ELASTOMERIC INSULATION:

Refrigerant Suction/Discharge and Hot Gas Bypass	Up to 1"	1"
	1½" and Above	1½"
Refrigerant Liquid	All Sizes	½"

3.04 FITTINGS, VALVES, STRAINERS, FLANGES, HEADERS, EXPANSION TANKS, HEAT EXCHANGERS, AIR CONTROL EQUIPMENT, PUMP SUCTION AND DISCHARGE INSULATION COVERS

- A. General: Provide all fitting insulation covers for pipe fittings, grooved end couplings, and for pipe flanges.
- B. Exposed Work: Provide "Zeston PVC" insulated fitting covers applied after pipe insulation is installed. A pre-cut "Hi-Lo Temp" insulation insert, conforming to the UL 25/50 rating, shall be snugly tucked around the fitting making sure the fitting is covered with the full thickness of insulation.
 - 1. All others, provide covering in pad form, constructed as follows: Use 1-inch thick Owens-Corning Fiberglas TIW Glass Wool, Type I, non-oiled, fully enclosed on all sides and edges within tight-weave canvas jacket. Attach Bergen hooks around edges of pad. Fit pad to device with edges tightly butted and secure with copper wire laced between hooks. Provide vapor seal where vapor seal is required for adjacent insulation.
- C. The one-piece UL 25/50 rated PVC fitting cover shall be snapped over the insulated fitting and secured with tack fasteners, staples, or tape.
- D. Gauge Lines: Insulate to the gauge shutoff valve.

3.05 PIPE HANGERS

- A. Do not allow pipes to come in contact with hangers.

END OF SECTION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Conform to General Conditions and Supplemental Conditions for Washington State Facilities Construction.
- B. The general Provisions of the Contract, including General, Supplementary, and Special Conditions, and Division 1-General Requirements, apply to work specified in this section. Subcontractor must familiarize himself with the terms of the above documents.

1.02 SCOPE OF WORK

- A. Scope of Work: Under the base bids, the controls as specified under Section 23 09 00 will be added to the project scope of work as a separate bid and pricing package. The following Stand Alone Controls manufacturers are approved for use on this project. No substitutions of manufacturers other than those listed will be considered. Input and output devices are not restricted to these manufacturers. Systems approved for bidding are:
 - 1. Approved Manufacturers:
 - a. Honeywell.
 - b. Trane.
 - c. Carrier

1.03 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

1.04 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level each separated by a defined deadband. Digital Inputs and Digital Outputs are examples.
- C. Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary installer, commissioner and ongoing service provider for the Controls work.
- D. Control Sequence: A pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- E. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the controls software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- F. Node: A digitally programmable entity existing on the controls network.
- G. PC: Personal Computer from a recognized major manufacturer. PC "clones" assembled by a third-party Subcontractor are not acceptable. PC must also have documentation verifying that it has been tested and is completely compatible with all installed software and communicates

with any peripherals such as modems, NEC cards, printers, hubs, zip drives, etc. that may be attached.

- H. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the controls wiring and terminations.
- I. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- J. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the controls industry for real-time, integrated controls configurations.
- K. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
AWG	-	American Wire Gauge
CFM	-	Cubic Feet Per Minute
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	(Binary) Digital Input
DO	-	(Binary) Digital Output
EEPROM	-	Electrically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAH	-	Outdoor Air Humidity

OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
TBA	-	To Be Advised
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current

1.05 QUALITY ASSURANCE

A. General:

1. The Contractor shall have a branch facility within a 100 mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. This branch facility shall provide the work for this project. This support facility shall have spare parts and all necessary test and diagnostic equipment required to install, commission and service the stand alone controls.
2. As evidence and assurance of the Contractor's ability to support the Port's system with service and parts, the Contractor must have been in business for at least the last ten (10) years and have successfully completed three projects comparable to the value of this contract in the preceding five years

B. Quality Management Program:

1. Provide a competent and experienced Project Manager employed by the Contractor. The Project Manager shall be supported as necessary by other Contractor employees in order to provide professional management service for the work. The Project Manager shall attend scheduled Project Meetings as required and shall be empowered to make technical, scheduling and related decisions on behalf of the Contractor.

1.06 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 916 Energy Management
5. NFPA 70 - National Electrical Code.
6. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.

7. NFPA 92A and 92B Smoke Purge/Control Equipment.
 8. Factory Mutual (FM).
 9. American National Standards Institute (ANSI).
 10. National Electric Manufacturer's Association (NEMA).
 11. American Society of Mechanical Engineers (ASME).
 12. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 13. Air Movement and Control Association (AMCA).
 14. Institute of Electrical and Electronic Engineers (IEEE).
 15. American Standard Code for Information Interchange (ASCII).
 16. Electronics Industries Association (EIA).
 17. Occupational Safety and Health Administration (OSHA).
 18. American Society for Testing and Materials (ASTM).
 19. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 20. Americans Disability Act (ADA)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.07 SUBMITTALS

- A. Control Drawings, Product Data, and Samples:
1. The Contractor shall submit a complete controls package divided in two sections. The first section shall be delivered within 30 days after the contract has been awarded and the second section shall be delivered within 60 days after the contract has been awarded.
 2. Allow at least 15 working days for the review of each package by the Engineer.
 3. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Engineer.
- B. Submittal Section 1:
1. Product data sheets for all products including software.
- C. Submittal Section 2:
1. Controller wiring diagrams and sequences. Control drawings shall be created on AUTOCAD software, version 14 or newer.
 2. Detailed Bill of Material, identifying part number, quantity, description, and optional features.
 3. Room Schedule including a separate line for each terminal unit showing system name, minimum/maximum cfm, box area, and number of reheat stages.
 4. Details of all interfaces and connections to the work of other trades.

1.08 RECORD DOCUMENTATION

- A. Operation and Maintenance Manuals:

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Engineer upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the controls provided:
 - a. Table of contents
 - b. As-built Control Drawings using AutoCAD Version 14 or newer. Drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturers product data sheets for all products including software.
 - d. System Operator's manuals.
 - e. Wiring termination diagrams (use AutoCAD version 14 or newer).
 - f. Interfaces to all third-party products and work by other trades.
 - g. Valve, Damper and Room Schedules
 - h. Point to point checkout sheets with dates and checkout signatures
 - i. Repair contact name and phone number.

1.09 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a one-year labor warranty on the Stand Alone Controls.
2. The controls components shall be free from defects in material and workmanship under normal use and service. If within one (1) year from the date of awarding of the Certificate of Occupancy any controls equipment is found to be defective, it will be replaced, repaired or adjusted by the Contractor free of charge. The Contractor is not responsible for the removal or reinstallation of any components that were originally installed by others, such as valves, dampers, wells, air flow stations, etc.
3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during Contractor's normal business hours unless there is an emergency.
4. Maintain an on-site record of all work done, all items removed from site, all items returned to site, all new replacement items installed and all remedial programming and database entry work undertaken including software revisions installed. Maintain a record of all re-calibrations required as a result of Warranty service.

1.10 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Not Applicable

2.02 STAND ALONE CONTROLS DESCRIPTION

- A. Each unit shall have individual stand alone controls that perform all the functions listed in the drawings. Stand alone controls described as programmable shall have 7 day programmable schedules with at least two cycles (off/on) per day and battery back-up, one cycle including

night setback. All programmable stand alone controllers shall have schedule override capabilities. All controllers shall have the ability to adjust the controlling variable setpoint. Units that control heating and cooling shall have a minimum 5°F heating and cooling deadband. Units controlling systems exceeding 10,000 CFM supply air shall have optimum start/stop. Unitary air cooled heat pump controllers shall minimize supplemental heat usage during start-up, set-up and defrost, use compressor as first heat stage and indicate visually, when the supplemental heat is active.

- B. The work of the single Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents as are listed in Part 1 of this Section.
- C. The controls work shall consist of the provision of all labor, materials, etc. as Specified in these Division documents which are required for the complete, fully functional and commissioned stand alone controls.
- D. Provide a complete, neat and workmanlike installation. Use only employees who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided for this Project.
- E. Manage and coordinate the controls work in a timely manner in consideration of the Project schedules. Coordinate cooperatively with the associated work of other trades so as to assist the progress and not impede or delay the work of associated trades.

2.03 NODES

A. HVAC Node:

- 1. HVAC Node shall provide stand alone direct digital control of HVAC systems.
- 2. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box)
- 3. Each HVAC Node shall retain its function and setpoint information in the event of a power failure, and shall return to normal operation upon restoration of power.
- 4. Each HVAC system with an economizer shall have an economizer control module included as part of the HVAC node control package.

PART 3 - PERFORMANCE/EXECUTION

3.01 CONTROLS SPECIFIC REQUIREMENTS

A. Temperature Sensors:

- 1. Office and classroom temperature sensors shall have pushbutton interface capabilities that allow for occupied/unoccupied override and adjustable setpoint unless otherwise specified on drawings. Sensors shall be capable of displaying room temperature and setpoint. Access to pushbutton override and setpoint adjustment shall be password protected.
- 2. Gyms, hallways and other high traffic areas subject to abuse shall have stainless steel, flush mounted, plain front temperature sensors.
- 3. Room temperature sensors shall be mounted 54" ADA unless otherwise specified on drawings. Verify locations with customer representative.

B. Actuation / Control Type:

1. Primary Equipment:

- a. As a default, spring return is required in all equipment exposed to outside air and/or fail safe situations.
- b. All air handling equipment damper and valve actuation shall be electric, spring return and proportionally controlled.
- c. Air handling equipment is defined as any unit with outside air intake.
- d. All valves associated with the main hydronic system and all valves directly processing outside air shall have mechanical override capabilities.
- e. All 120 VAC driven actuators shall have disconnects in accordance with electrical standards.

2. Terminal Equipment:

- a. Terminal Air Boxes (VAV, etc.) shall have electric damper and valve actuation. 3 point floating actuation is acceptable.
- b. Hydronic Based Heaters shall have electric actuated valves with electric thermostat control.

C. Economizer Modules:

1. Module shall operate from the space thermostat as first stage of cooling and shall have as a minimum, dry bulb temperature change over control, minimum damper position potentiometer and compressor staging relay functions. Economizer module shall be capable of enthalpy and CO2 control if required.

D. Adjust room numbers and floor plans as necessary to reflect actual conditions.

3.02 INSTALLATION PRACTICES

A. Stand Alone Controls Wiring:

1. All conduit, wiring, accessories and wiring connections required for the installation of the Stand Alone Controls, as herein specified, shall be provided by the Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
2. All wiring materials and installation methods shall comply with manufacturer recommendations.
3. The sizing type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Wire/conduit ratios shall follow the same wire/conduit ratios included in Division 26.
5. Class 2 Wiring:
 - a. All Class 2 (24VAC or less) wiring shall be installed in conduit or be plenum rated and shall be installed in accordance with local code requirements.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Inaccessible locations such as "hard lid" ceilings require conduit.

- c. Wire supports and be installed per local wiring code requirements. As a default, wire shall be supported every 5' from the building structure utilizing metal hangers designed for this application.
 - d. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Engineer.
 - e. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 - f. Provide firestopping for all penetrations used by dedicated Controls conduits and raceways using approved fire resistive sealant. All other project firestopping to be by other trade.
 - g. All wiring passing through penetrations, including walls or other structure, shall be in conduit or enclosed raceway.
 - h. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.
 - i. No penetrations in structural elements shall be made before receipt of written approval from the Structural Engineer.
6. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
7. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
- a. All circuits are continuous and free from short circuits and grounds.
 - b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
 - c. All circuits are free from induced voltages.
8. Provide complete testing for all cables used under this Contract. Provide all equipment, tools, and personnel as necessary to conduct these tests.
9. Provide for complete grounding of all signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- B. Controls Line Voltage Power Source:
- 1. 120-volt AC circuits used for the controls shall be taken from panelboards and circuit breakers provided by Division 26. Coordinate circuit installation with Division 26. Division 26 shall be responsible for the installation of 120 VAC controls circuits.
 - 2. Circuits used for the controls shall be dedicated and shall not be used for any other purposes.
 - 3. Terminal unit controllers may use 120-volt AC power from motor power circuits.
- C. Controls Identification Standards:
- 1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node location.
 - 2. Cable and/or conduit shall be labeled at suitable intervals with the controlled unit's name. Labeling shall be sufficient to trace cable from device to unit.

3. Specify a different wire color for analog, digital, power and communication wiring. Include wiring color on control drawings legends.
 4. Raceway Identification: All the covers to junction and pull boxes of the controls raceways shall be labeled.
 5. Wire Identification: All low and line voltage control wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.
- D. Stand Alone Node Installation:
1. The controls panels and cabinets shall be mounted at shoulder height wherever possible. All panels shall be accessible. Each cabinet shall be anchored per the manufacturer's recommendations.
 2. The Contractor shall be responsible for coordinating panel locations with other trades and Electrical and Mechanical Contractors.
- E. Input Devices:
1. All Input devices shall be installed per the manufacturer recommendation and shall be of the type and accuracy suitable for this specific application.
 2. Locate components in accessible local control panels wherever possible.
 3. The Contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
 4. Outside Air Sensors:
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
 5. Water Differential Pressure Sensors:
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location.
 - d. Installation of pipe taps and shutoff valves by Division 23.
 6. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
 - b. Installation of pipe taps, valves and air bleed units by Division 23.
 7. Building Differential Air Pressure Applications (-0.25" to +0.25" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.

8. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
 9. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water or steam coil in the air stream.
 - b. Mount element horizontally across coil in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
 10. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
 11. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
 - b. Installation of pipe taps and valves by Division 23.
 12. Room Temperature Sensor:
 - a. Install sensor with insulation if mounted on an exterior wall.
- F. HVAC Output Devices:
1. All output devices shall be installed per the manufacturers recommendation and shall be suitable in type and accuracy for this specific application. The Contractor shall install all in-line devices such as control valves, dampers, etc.
 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
 3. Electronic Signal Isolation Transducers: Whenever an analog output signal from the controls are to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. It is the Controls Contractor's responsibility to determine if isolation is necessary.
 4. Relays: All relays used to start/stop any piece of mechanical equipment that does not have an HOA switch shall have a Closed-Open-Auto override switch located on the load side of the relay.

3.03 TRAINING

- A. The Contractor shall provide the following training services:
 - 1. Provide one day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings and a walk through of the facility to identify panel and device locations. Training may be split into smaller sessions on different days if the Owner prefers.
 - 2. Supply a list of available factory training classes and contact information.

3.04 COMMISSIONING

- A. Contractor shall provide the Commissioning Agent with a completed Acceptance Verification document prior to beginning point-to-point activities. Final Acceptance Verification document shall be included in the Commissioning Field Notebook. The commissioning agent may be an independent agent, the customer, or the Design Engineer.
- B. Acceptance Verification Document is defined as a series of check sheets that include all stand alone controls and functions. Each point entry shall be signed and dated verifying that each point and function has been fully calibrated and tested.
- C. The Contractor shall provide qualified technician to support the commissioning requirements. The Contractor shall provide support to the commissioning agent during the performance testing and shall provide trends as needed for their review.
- D. Conduct functional performance tests to demonstrate that controls systems maintains setpoints and operates through the full range of operations. The commissioning agent will provide functional tests that the Contractor shall review and provide comments on the tests for incorporation into the final test documents.
- E. Provide all necessary specialist labor, materials and tools to demonstrate to the Engineer that the stand alone controls have been commissioned and are operating in compliance with the contract. Prepare a list of noted deficiencies signed by both the Engineer and the Contractor.
- F. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 2. Section 23 31 13.01 – “Steel Ductwork”

1.02 GENERAL

- A. Includes sleeving and sealing of piping and ductwork.

1.03 REFERENCES

- A. ASTM E814: Fire Tests of Through-Penetration Fire Stops
- B. UL 1479: Through-Penetration Fire Stop Systems.

1.04 SUBMITTAL REQUIREMENTS

- A. Submittal requirements for this Section.
 - 1. Seals

1.05 OPERATION AND MAINTENANCE REQUIREMENTS FOR THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Products shall comply with Section 20 00 00.01, paragraph 2.01, Approved Manufacturers.
- B. Fire Seals: 3M, Dow Corning, General Electric, Rectorseal Metacaulk.

2.02 PIPE SLEEVES

- A. Size: Inside diameter of pipe sleeves shall be at least 1/2-inch larger than the outside diameter of the pipe or pipe covering, so as to allow free movement of piping.
- B. Ends: Sleeve ends shall be cut flush with finished surfaces, except in rooms having floor drains where sleeves shall be extended 3/4-inch above finished floor.
- C. Material - Structural: Sleeves through structural elements shall be fabricated from Schedule 40 steel pipe.
- D. Material - Non-structural: Sleeves through non-structural elements shall be fabricated from 18 gauge galvanized sheet metal or 24 gauge spiral duct.
- E. De-burr pipe ends and smooth slab penetration (to accept final slab finish) from sleeves extending above finished floor.

2.03 DUCT SLEEVES

- A. Size: Inside dimension of sleeves shall be at least 1/2" larger than the outside dimensions of the duct or duct covering on all sides.
- B. Ends: Sleeve ends shall be cut flush with finished surface.

- C. Material - Non-structural: Sleeves shall be fabricated from 20 gauge galvanized steel, shall be continuous around the interior without holes or openings, and shall match the configuration of the item being sleeved.
- D. Material - Structural: Sleeves through structural elements shall be fabricated from Schedule 40 steel pipe (round openings) and welded steel supporting elements (sizes/arrangement as shown on drawings) for other openings.

2.04 SEALS

- A. Seals in Interior Fire Rated Assemblies: Shall be tested in accordance with ASTM E814 and shall be UL classified per UL 1479 as a through-penetration fire stop device.
- B. Seals in Exterior Masonry Walls and Floors:
 - 1. Piping: Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. The seal assembly shall expand when mechanically tightened to provide an absolute watertight seal between the pipe and wall opening. Sizing shall be per manufacturer's recommendations. Seal shall be Thunderline "Link-Seal" or approved equal.
 - 2. Ducts: Silicone type sealant, designed for use with duct material involved as weatherproof sealant and as specified in Section 07 92 00.01.
- C. Seals In Other Areas: Packed fiberglass or wool insulation, where no weatherproofing or adhesive properties are required; otherwise, sealants shall be silicone type, as specified in applicable Division 7 Specification Section.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE SLEEVES

- A. Provide pipe sleeves for all piping passing through walls, floors, partitions, roofs, foundations, footings, grade beams, and similar elements, except that sleeves are not required for penetrations through existing single solid elements, having no voids, at the location where the piping passes through the solid elements (e.g., solid wood stud, core drilled solid concrete, etc.). Where a sleeve is required, such sleeve shall continue all the way through any solid items within that element.
- B. Set sleeves plumb or level (or sloped as required for drainage pipe) in proper position, tightly fitted into the work.
- C. Fill openings around outside of pipe sleeve with same material as surrounding construction, or with material of equivalent fire and smoke rating.
- D. Seal around all pipes inside of pipe sleeve.
- E. Insulation shall run continuous through sleeves in non-fire rated elements. Insulation shall not run continuous through sleeves in fire rated elements unless the fire sealant system used is UL accepted for use with insulated pipes.
- F. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade.

3.02 INSTALLATION OF DUCT SLEEVES

- A. Provide duct sleeves for all round ducts less than 15 inches in diameter where the duct passes through any floors, walls, ceilings, partitions, or roofs and similar elements.

- B. Provide duct sleeves for all square and rectangular ducts having their largest dimension 14 inches and less where the duct passes through any floors, walls, ceilings, partitions, roofs, and similar elements.
- C. Round ducts larger than 15 inches in diameter, and square or rectangular ducts larger than 14 inches in any dimension, shall have framed openings where the duct passes through any element. Such framed openings shall be of the same type as the structural materials used in the wall and shall comply with materials specified for this project. Sleeves shall be provided in addition to the framed opening where any void space(s) occurs through the penetration (as through CMU walls, double walls, etc.).
- D. Set sleeves plumb or level, in proper position and location, tightly fitted into the work.
- E. Fill openings around outside of duct sleeve with same material as surrounding construction, or with material of equivalent fire and smoke rating.
- F. Sleeves are not required for penetrations through existing single solid elements, having no voids, at the location where the duct passes through the element (e.g., precast concrete panels with pre-framed openings, core drilled/saw cut solid concrete, etc.). Where a sleeve is required, such sleeve shall continue all the way through any solid items within that element however.
- G. Insulation shall run continuous through sleeves in non-fire rated elements. Insulation shall not run continuous through sleeves in fire rated elements unless the fire sealant system used is UL accepted for use with insulated pipes.
- H. Sleeves for fire dampers shall be as specified for fire dampers and be in compliance with the damper UL listing.

3.03 INSTALLATION OF SEALS

- A. Provide seals around all piping and ducts passing through walls, floors, roofs, foundations, footings, grade beams, partitions, and similar elements.
- B. Seals shall be of material and workmanship to maintain the fire and smoke rating of element being penetrated. Seals ability to maintain the rating of the element being penetrated shall be listed in UL Laboratories Building Materials Directory or otherwise confirmed by an approved listing agency. It shall be the Contractor's responsibility to submit shop drawings and technical data showing seals and systems proposed, and corresponding agency approval. The Contractor shall also be responsible to submit any data as required by local agencies to satisfy them that the Contractor's proposed fire seals are satisfactory.
- C. Seals shall be watertight where the penetration may be exposed to water or moisture.
- D. Duct penetrations through roof or exterior wall assemblies shall be provided with flashings for a weathertight assembly in accordance with SMACNA HVAC Duct Construction Standards. Such openings shall be sealed to be weatherproof.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 22 11 16.01 – “Domestic Water Pipe and Fittings”
 - 3. Section 22 20 00.01 – “Excavation and Backfill For Mechanical Underground Utilities”
 - 4. Section 23 05 29.01 – “Hangers and Supports for HVAC Piping and Equipment”
 - 5. Section 23 07 19.01 – “HVAC Piping Insulation”

1.02 GENERAL

- A. Includes, but not limited to, the furnishing and installation of piping for refrigeration systems. The general arrangement and location of piping is shown on the plans. The pipe sizing and exact arrangements shall be designed by this contractor. This contractor shall provide all labor, materials, equipment, refrigeration specialties, testing, evacuation, oil and refrigerant charging as required for a complete and operational system. The design and installation shall conform to the equipment manufacturer's recommendations and installation instructions and all local mechanical and environmental codes.
- B. Single line indicated on plans designates the proposed routing for the refrigeration piping between the indoor and outdoor units. That single line represents all the required piping runs required for the system designed. Contractor to verify quantity of circuits, piping runs and sizing prior to bid and installation.

1.03 QUALITY ASSURANCE

- A. Refrigerant piping shall be installed by a refrigeration contractor licensed in the State of Washington, having a minimum of five (5) years experience in refrigeration piping installation, and certification of technical training specifically in refrigeration from an industry recognized training program. Proof of license, experience and training shall be submitted as part of the Mechanical Submittals. All technicians working on-site shall be certificated in the use and handling of refrigerants in accordance with federal EPA regulation 40 CFR Part 82, sub-paragraph F.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Pipe
- B. Fittings
- C. Brazing Material
- D. Accumulators (Separate from Equipment)
- E. Expansion Valves (Separate from Equipment)
- F. Isolated Valves
- G. Filters/Driers
- H. Shop Drawings and Calculations
- I. Refrigeration Contractor Qualifications

1.05 OPERATION AND MAINTENANCE REQUIREMENTS FOR THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 REFRIGERANT PIPING

- A. Meet the requirements of ASTM B 280-86, "Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service", ACR hard drawn straight lengths.
- B. Use of pre-charged soft copper line sets is prohibited.

2.03 REFRIGERANT FITTINGS

- A. General: 100% Wrot copper with long radius elbows.
- B. Approved Manufacturers: Mueller Streamline, Nibco.

2.04 BRAZING MATERIAL

- A. Brazing rods with a minimum of 5% silver content shall be utilized. Rods containing Cadmium will not be permitted.

2.05 ACCUMULATORS

- A. Accumulators are typically furnished as an integral component of the refrigeration equipment however the capacity of the provided accumulator shall be verified in each installation. Should additional accumulators be required to support larger refrigerant charges due to long piping runs, they shall be sized, furnished and installed by this contractor. Include all calculations in submittal to Engineer.

2.06 EXPANSION VALVES

- A. Expansion valves are typically furnished as an integral component of the refrigeration equipment however should the selection of equipment require field installation of the expansion valve, it shall be provided by this contractor. Expansion valves shall be selected as recommended by the manufacturer for the individual coil, tonnage, refrigerant and system pressures. Size valves to provide full rated coil capacity and indicated on the equipment schedules. Adjust final superheat temperature settings to those recommended by equipment manufacturer.

2.07 ISOLATION VALVES

- A. Line size, ball type isolation valves shall be provided on both vapor and liquid lines of all systems. Provide one vapor and 2 liquid line valves (for filter/drier isolation) at the outdoor unit.
- B. Valves shall be suitable for use with HCFC and HFC refrigerants, forged brass body, seal cap and wrot copper fitting extensions. Temperature rating shall be -40°F to +325°F minimum.
- C. Coordinate optimum location of valves with filter/dryer unit (a valve on each side of the filter) to facilitate replacement with minimal loss of refrigerant. At minimum, provide one set of schrader valves located on the indoor coil side of the valves to facilitate evacuation and charging of the piping.

2.08 FILTER/DRIERS

- A. All systems shall be provided with field installed, bi-directional, liquid line filter drier units. This filter shall be provided regardless of whether the unit is provided with one, sized to provide rated tonnage as indicated on the equipment schedule plus 50% while maintaining a 2 PSIG or less pressure drop. Provide filters with SAE flare type fitting for ease in replacement.

PART 3 - EXECUTION

3.01 SHOP DRAWINGS AND CALCULATIONS

- A. Provide shop drawings of each system in the project. Drawings are to be at 1/8th inch per foot minimum, and in sufficient detail to count fittings and devices with all vertical and horizontal runs fully dimensioned. Show sizes of all piping and type of fittings. Provide large scale details of indoor and outdoor equipment connections with all devices located, chases through the building components, refrigerant traps, and underground piping runs.
- B. Provide calculations that support the shop drawings with an individual pipe sizing calculation for each piping system. These calculations are to be performed by the equipment manufacturer's technical support personnel and submitted to the Engineer. These calculations shall provide total system capacity loss due to piping, system vapor velocities and critical system operating temperatures.
- C. **All piping systems shall be sized as required to prevent no more than 5% system capacity loss due to piping.**
- D. Each piping system is to be individually sized accounting for that particular unit's capacity, piping lengths, fittings and devices. Oil return is a major consideration and refrigerant vapor velocity must be sufficient to entrain oil. Minimum velocity must be 800 fpm in horizontal runs and 1500 fpm in vertical suction risers.

3.02 PIPING INSTALLATION

- A. All vapor lines shall be sloped downward towards the compressor at a rate of one (1) inch per 10 lineal feet to facilitate oil return.
- B. Provide oil traps at vertical risers where required to return oil to compressor and to prevent liquid migration back to the compressor in the off cycle.
- C. Refrigeration system connections shall be copper-to-copper type properly cleaned and brazed. Use flux only where required for brazing brass components. Soft solder connections are prohibited. Only silver solder containing a minimum of 5% silver shall be utilized.
- D. Circulate dry nitrogen as a shield gas through piping while being brazed to eliminate formation of copper oxide during brazing operation.
- E. All piping shall be secured using unistrut type channel with "Hydrosorb" type clamps. All clamps shall be specifically designed for use with refrigeration piping and shall contain internal plastic grommet for vibration and thermal isolation. The use of general purpose clamps, conduit straps or plumbers tape is strictly prohibited. Carefully plan routing and grouping of all piping to ensure a neat and professional installation.
- F. Where necessary to offset piping around obstructions, utilize 45° elbows in lieu of 90° elbows to minimize pressure losses.
- G. Where piping is installed underground, provide an utilidor or conduit type system in which all piping shall be routed and protected against physical damage and moisture. Refer to drawings for additional installation details.

- H. A complete review of all installation recommendations produced by the equipment manufacturer is recommended prior to the installation of ACR piping. Conformance to all manufacturers' recommendations will be enforced.
- I. All leak testing shall be performed and verified prior to covering any concealed or buried piping. See Field Leak Tests.

3.03 FIELD LEAK TESTS

- A. All leak tests shall be witnessed and confirmed by the Engineer. The purpose of all leak testing is to confirm the integrity of field installed piping. If equipment is provided with a factory provided refrigerant charge, the equipment may be isolated and excluded from the test. If shipped with only a "holding charge" or no charge, the isolation valves shall be opened, and the equipment shall be included in the pressure testing.
- B. Following completion of the refrigeration piping systems, the following tests shall be performed.
 - 1. Connect test gauge with minimum of "2% accuracy to the piping system to be tested and pressurize piping system with dry nitrogen gas to 1.25 x design service pressure (minimum of 250 psi) or as recommended by the equipment manufacturer. Do not introduce any refrigerant into the system prior to pressure testing. The test gauge shall remain connected throughout the test period. Record actual test gauge pressure, date, time and ambient temperature. System shall remain under test for a period of one week. At the conclusion of the test period, record pressure, date, time and ambient temperature. If the test gauge is within 1% (2.5 PSIG) of the original test pressure as witnessed by the Engineer, (plus adjustment fluctuations in ambient temperatures) the system will be "Passed" and approved for evacuation and charging procedures.

3.04 OIL/REFRIGERANT CHARGING

- A. Prior to commencing oil and refrigerant charging procedures, this Contractor shall refer to and closely follow the manufacturers' specific procedures for charging the system. As a minimum, the following procedures shall be followed:
 - 1. Calculate oil charge using manufacturer's recommended method and add oil to compressor crankcase as necessary for size of piping system. Affix permanent, weatherproof label to unit indicating date, type of oil, and amount added, signed by the technician performing the task.
 - 2. Draw a vacuum on each entire system with vacuum pump to 200 microns using vacuum gauge calibrated in microns. Break vacuum with refrigerant shipped with unit and re-establish a 200 micron vacuum (double evacuation). Calculate recommended charge and add the appropriate refrigerant charge by weight using a digital scale. Check and adjust charge as necessary to obtain manufacturer's specified operating pressures and superheat during start-up procedure.

3.05 SYSTEM START-UP

- A. Perform a system start-up and check-out procedure as recommended by the equipment manufacturer, and as indicated on the enclosed system Start-up and Check-out Log. This start-up and check-out shall be performed in the presence of the Engineer.
- B. Provide one week's written notice to the Engineer prior to start of equipment start-up and check-out.
- C. Submit the following completed documentation including copies of the completed compressor warranty registration forms to the Engineer upon completion of system start-up.

3.06 START-UP LOG

- A. See Start-up Log form provided at the back of this specification section.

END OF SECTION

START-UP LOG

Date: _____ Project Title: _____

Contractor: _____ Tech. Name: _____

Refrigerant License #: _____

EQUIPMENT:

	<u>Indoor</u>	<u>Outdoor</u>	<u>Accessories</u>
Unit #:	_____	_____	_____
Make:	_____	_____	_____
Model:	_____	_____	_____
Serial#:	_____	_____	_____
Location:	_____	_____	_____

REFRIGERANT CHARGE: Type: _____ Amount: _____

OIL CHARGE: Type: _____ Amount: _____

TEMPERATURES:

Indoor: _____ Outdoor: _____
Return Air: _____ Supply Air: _____

COMPRESSOR(S):

	<u>#1</u>	<u>#2</u>
	<u>Cooling</u>	<u>Cooling</u>
Discharge Pressure:	_____	_____
Suction Pressure:	_____	_____
	<u>Actual</u>	<u>Rated</u>
Amps:	_____	_____
Volts(at disconnect) L1 - L2 ____ L2 - L3 ____ L1 - L3	_____	_____

INDOOR MOTOR:

Direct Drive _____ Belt Drive _____ Belt Size _____
Amps-Actual _____ Amps-Rated _____ Volts _____
Rotation Verified? Yes () No ()

OUTDOOR MOTOR:

Amps-Actual _____ Amps-Rated _____ Volts _____

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Conditions”
 - 2. Section 23 05 29.01 – “Hangers and Supports for HVAC Piping & Equipment”
 - 3. Section 23 07 13.01 – “Equipment/Ductwork Insulation”
 - 4. Section 23 33 00.01 – “HVAC Specialties”

1.02 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Duct liner
- B. Acoustic duct
- C. Access doors
- D. Volume dampers
- E. Motorized dampers
- F. Duct Silencers
- G. Duct Sealers
- H. Duct Closure Collars
- I. Turning vanes

1.03 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Motorized dampers

1.04 DEFINITIONS

- A. Duct Sizes: All duct dimensions shown are inside clear dimensions. Where inside duct lining is specified or indicated, duct dimensions are to the inside face of lining.
- B. Low Pressure System: Velocities less than 2,000 fpm and static pressure in duct 2 inches w.g. or less.
- C. Medium Pressure System: Velocities greater than 2,000 fpm or static pressure in duct up through 6 inches w.g.
- D. High Pressure System: Velocities greater than 2,000 fpm or static pressure in duct over 6 inches w.g. and up to 10 inches w.g.
- E. Primary Duct System: Any duct between an air handler and a terminal (capable of heating and/or cooling) in a variable air volume or induction terminal system.
- F. Gauges: Steel sheet and wire are U.S. Standard Gauge; aluminum sheet is Brown and Sharpe Gauge.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 DUCTS

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal, except as indicated. Fabricate of zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A 527-85, "Specification for Sheet Steel Zinc Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality", with G 60 coating.
- B. Construct T's, bends, and elbows with radius of 1-1/2 times width of duct on centerline. Where not possible, provide turning vanes.
- C. Increase duct sizes gradually, not exceeding 30° divergence and 45° convergence.
- D. Use crimp joints with or without bead for joining round duct sizes 8 inches (200 mm) and smaller with crimp in direction of airflow.
- E. Kitchen Hood Exhaust Ductwork: Fabricate in accordance with NFPA 96.
- F. Fume hood exhaust ductwork shall conform to the IMC, Chapter 5.

2.03 DUCT JOINTS

- A. General: Duct with sides or diameter up to and including 36 inches shall be as scheduled below.

Max. Side Inches	Required Minimum Metal Gauges Steel, U.S. Standard Gauge	Type of Transverse Joint Connections	Bracing Required
Under 13"	26	S-drive, pocket or bar slips on 7 - 10" centers	None
13" to 24"	24	S-drive, pocket or bar slips on 7-10" centers	None
25" to 30"	24	S-drive, 1" pocket or 1" bar slips on 7'-10" centers	1"x1"x1/8" angles 4' from joints
31" to 36"	22	Drive 1"pocket or 1"bar slips on 7'-10" centers	1"x1"x1/8" angles 4' from joints

- B. Ducts with sides over 36 inches to 48 inches, transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA "E" or "G" Type connection).
- C. Ducts 48 inches and larger, Ductmates/35, Nexus, or WDCI (Heavy) (SMACNA "J" Type connection).
- D. Proprietary duct connections may be used on other sizes, Ductmate, WDCI, or equal.

2.04 SPIRAL DUCT

- A. The outer pressure sheet shall be manufactured from galvanized steel meeting ASTM A-527-67 in the following minimum gauges:

Nominal Size Range	Solid Spiral Wound Duct Outer Pressure Shell	Solid Welded Fitting Outer Pressure Shell
3"-12"	26 Ga.	20 Ga.
13"-24"	24 Ga.	20 Ga.
25"-34"	22 Ga.	20 Ga.
35"-48"	20 Ga.	18 Ga.
50"-58"	18 Ga.	16 Ga.

2.05 DUCT LINER

A. Densities and R-value:

1. R-3.3: 1.0 inch of 1.5 to 3.0 lb/cu. Ft. duct liner.
2. R-5.3: 1.5 inches of 1.5 to 3.0 lb/cu. Ft. duct liner.
3. R-7: 2.0 inches of 1.5 to 3.0 lb/cu. Ft. duct liner

B. Duct Liner:

1. 'K' ('ksi') Value: ASTM C518, 0.25 at 75°F (0.036 at 24°C).
2. Noise Reduction Coefficient: 0.65 or higher based on "Type A mounting".
3. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min (25.4 m/sec).
4. Adhesive: UL listed waterproof type.
5. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
6. Approved Manufacturers:
 - a. Manville Linacoustic (Mat Faced)
 - b. Permacote (meeting ASTM C1071)

C. Spiral Duct Liner:

1. For ductwork requiring 1-inch (25 mm) Spiracoustic Plus System Lining:
 - a. The installed 1-inch lining shall have a Thermal Resistance (R-Value) of 4.3 (.76) at 75°F (24°C) mean temperature, and Noise Reduction Coefficients (NRC) per ASTM C 423, Type "A" mounting.
 - b. Metal duct with inside diameters from 8 inches to 18 inches (203 to 457 mm) shall be lined with 1-inch Preformed Round Liner.
 - 1) Approved Manufacturers:
 - (a) Permacote Spiracoustic Liner
 - c. Metal duct with inside diameters from 18 inches to 32 inches (457 to 813 mm) shall be lined with 1-inch Round Liner Board.
 - 1) Approved Manufacturers
 - (a) Spiracoustic Plus "SD" Liner
 - d. Metal duct with inside diameters greater than or equal to 34 inches (364 mm) shall be lined with 1-inch Round Liner Board.
 - 1) Approved Manufacturers

(a) Spiracoustic Plus "LD" Liner

2. For ductwork requiring 1 1/2-inch (38 mm) Lining:
 - a. The installed 1 1/2-inch lining shall have a Thermal Resistance (R-Value) of 6.3 (1.11) at 75°F (24°C) mean temperature, and a Noise Reduction Coefficient (NRC) of 0.95 per ASTM C 423, Type "A" mounting.
 - b. Metal duct with inside diameters from 9 inches to 18 inches (229 to 457 mm) shall be lined with 1 1/2-inch Preformed Round Liner.
 - 1) Approved Manufacturers:
 - (a) Permacote Spiracoustic Liner
 - c. Metal duct with inside diameters from 22 inches to 38 inches (559 to 965 mm), shall be lined with 1 1/2-inch Round Liner Board.
 - 1) Approved Manufacturers:
 - (a) Spiracoustic Plus "SD" Liner
 - d. Metal duct with inside diameters greater than or equal to 40 inches (1.02 m), shall be lined with 1 1/2-inch Spiracoustic Plus LD Round Liner Board.

D. Fiber Free Duct Liner (Rectangular/Spiral):

1. Liner shall be fiber-free, closed cell type.
2. Provide with factory applied pressure sensitive adhesive.
3. Shall meet the requirements of NFPA 90A and 90B for Duct Coverings and Linings, and UL 181 for Mold Growth.
4. Liner shall be rated to withstand temperature up to 250°F.
5. Liner shall meet the requirements of the International energy Conservation Code (IECC) and ASHRAE for R-Value 4.2 at 1" thickness.
6. Approved Manufacturers:
 - a. Armacell
 - b. K-Flex Duct Products

2.06 ACCESS DOORS IN DUCTS

- A. At each backdraft damper and at each motorized damper, install factory built 1" insulated access door with hinges and sash locks. Locate doors within 6 inches of installed dampers. Construction shall be galvanized sheet metal, 22 ga. minimum frame and 24 ga. minimum door. Minimum door shall be 12x12. If duct is too small for 12" door, then maximum door size shall be installed in duct.
- B. Access doors for fire damper shall have a minimum clear opening of 12"x12" or as specified on Drawings to easily service fire damper. Doors shall be within 6 inches of fire dampers.
- C. Approved Manufacturers:
 1. Nailor - Hart Industries Inc.
 2. Cesco - Advanced Air
 3. AirBalance Fire/Seal

4. Louvers & Dampers
5. Kees Inc.
6. Ductmate Industries Inc "Sandwich" Access Door
7. National Controlled Air Inc.
8. Greenheck
9. Elmdor

2.07 FLEXIBLE EQUIPMENT CONNECTIONS

- A. Provide flexible equipment connections between ductwork and equipment. See Section 23 33 00.01 - HVAC Specialties.

2.08 VOLUME DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Fabricate splitter dampers of same material and gage as duct to 24 inches (600 mm) size in either direction, and two gages heavier for larger sizes, secured with continuous hinge or rod, operated with minimum 1/4-inch (6 mm) diameter rod.
- C. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch (240 x 760 mm).
- D. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch (300 x 825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. Except in round ductwork 12 inches (300 mm) in diameter and smaller, provide end bearings.
- F. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where width exceeds 30 inches (750 mm), provide regulator at both ends.

2.09 MOTORIZED DAMPERS

- A. General:
 1. Coordinate actuator type with Contractor.
 2. Make provision for damper actuators and actuator linkages to be mounted external of airflow.
 3. Shall be Class IA.
- B. Damper Blades:
 1. 18-gauge or equivalent galvanized steel or aluminum with replaceable rubber blade edges, 9 inches wide maximum.
 2. End seals shall be flexible metal compression type.
 3. Opposed blade type
- C. Performance:
 1. Maximum leakage rate shall be 4 cfm/sq. ft. of damper area per 1.0 inch w.g. in accordance with AMCA Standard 500D.
- D. Approved Manufacturers:
 1. Honeywell

2. Johnson
3. Ruskin
4. Louvers & Dampers
5. Arrow OBD AF
6. American Warming
7. Greenheck

2.10 DUCT HANGERS

- A. See Section 23 05 29.01 - Hangers and Supports for HVAC Piping & Equipment.

2.11 DUCT SEALANT AND ADHESIVES

- A. Duct Sealant technical makeup shall be water based, solvent-free and of the synthetic latex family. Sealants shall be UL 181 Listed, meet all SMACNA pressure and seal classes and be rated to ± 15 inches water gauge. Sealants shall have flame spread of 0 and smoke development of 0 when tested in accordance to ASTM E-84. They shall be formulated to withstand working temperatures of -25°F to $+200^{\circ}\text{F}$. All sealants shall exceed 500 hours under ASTM C-732 (Artificial Weathering) and pass ASTM C-734 (Low Temperature Flexibility after Artificial Weathering). All sealants shall be of an elastomeric nature, have a minimum weight of 12 pounds and a minimum solids content by weight of $66\% \pm 2\%$. Sealants shall be resistant to cracking, peeling, mold and mildew. Sealants shall also have excellent water and UV resistance. Sealants shall meet FDA, USDA and EPA standards as well as meet NFPA 90A and 90B requirements. Sealant shall be Design Polymeric DP 1010 or DP 1020 duct sealant or equal.
- B. Solvent based duct sealant VOC shall be less than or equal to 50 g/l and be UL 723 Classified with a flame spread of 0 and a smoke development of 0. Sealant shall have passed 1000 hours of QUV accelerated outdoor aging testing. Sealant shall be Design Polymeric DP 1090 duct sealant or equal.
1. All traverse joints, longitudinal seams and penetrations in duct systems shall be sealed with duct sealant of the type specified. Spiral lockseams are not longitudinal seams and do not require duct sealant. All sealant shall be applied per the manufactures' recommendations. Joints that are not fully welded shall be sealed. For spiral and flat oval duct slip connections; coat both the female and male ends. The slip connections should then be brushed over with an additional coat 2 to 3 inches wide 20 to 40 mils thick.
 2. All conditioned air supply ducts, return ducts and fresh air intakes shall have all joints and seams sealed or welded, except spiral seams round and flat oval ducts, which are exempt.
 3. Seal sealants and joint sealants shall not be used as a substitute for good workmanship. No ductwork will be covered or installed until inspected and pressure tested if necessary.
- C. Gaskets for TDC, TDF and applied flange connections shall meet all SMACNA pressure and seal classes. The gasket shall meet UL 723, ASTM E-84, NFPA 90A and 90B requirements as well as FDA, USDA and EPA standards. The tape shall be 5/8 inches by 3/16 inches and applied according to the manufactures' directions. Expanded or extruded foam gaskets are not acceptable. Gasket shall be Design Polymeric DP 1040 Butyl Gasket Tape or equal.
- D. Exterior Ductwork: Sealant shall be Design Polymeric DP 1090, or equal.

2.12 DUCT CLOSURE COLLARS

- A. General: Closure collars shall provide closure of opening between duct and opening in element penetrated and shall abut tight up to and overlap duct and shall consist of rolled angle material (for round ducts) and welded framed angles (for rectangular/round ducts).
- B. Size: Closure collars shall be sized to match duct/opening applied to and shall have minimum 2-inch overlap on duct side and 2-inch overlap at opening/ penetrated element side but shall completely cover opening in element penetrated with minimum 1-inch overlap to undisturbed element (i.e., wall, floor, etc.).
- C. Material: Closure collars shall be fabricated of 20 gauge galvanized steel for ducts 15 inches diameter and less and shall be fabricated of 18 gauge galvanized steel duct for all larger ducts and all square and rectangular ducts.

2.13 TURNING VANES

- A. Turning vanes may be either Contractor or factory fabricated. Factory fabricated vanes shall be Barber Colman "Airturns" or approved.
- B. Vanes and runners shall be fabricated of minimum 24 gauge galvanized.
- C. Turning vanes shall comply with SMACNA HVAC Duct Construction Standards. For duct widths less than 19 inches, vanes may be single wall construction; for widths greater than 19 inches, vanes shall be double wall "airfoil" type.
- D. Turning vanes shall be equally spaced, parallel to each other, and securely attached to runners.
- E. For elbows where the inlet and outlet dimensions are not the same, modify vane shape or angle to provide optimum turning.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Ducts:
 - 1. Straight and smooth on inside with joints neatly finished unless otherwise directed.
 - 2. Duct panels through 48-inch dimension having acoustic duct liner need not be crossbroken or beaded.
 - 3. Crossbreak unlined ducts and duct panels larger than 48 inch or bead 12 inches on center.
 - 4. Securely anchor ducts to building structure with screws.
 - 5. Brace and install ducts so they shall be free of vibration under all conditions of operation.
 - 6. Round, horizontal ducts shall be hung with bands, which extend the entire perimeter of the duct.
 - 7. Ducts shall be braced and guyed to prevent lateral or horizontal swing.
 - 8. Ducts shall not bear on top of structural members.
 - 9. Make duct take-offs to branches, registers, grilles, and diffusers as detailed on Drawings.
 - 10. Ducts shall be large enough to accommodate inside duct liner. Dimension shown on Drawings are net clear inside dimensions after duct liner has been installed.
 - 11. Properly flash where ducts protrude above roof.

12. Install internal ends of slip joints in direction of flow. Make joints airtight using specified duct sealer.
13. Cover horizontal and longitudinal joints on exterior ducts two layers of Hardcast tape installed with Hardcast HC-20 adhesive according to Manufacturer's recommendations.
14. Ducts installed on mechanical space floor or walkway where ducts may be subject to abuse shall have Ductmate/35 or (heavy) SMACNA "J" type connection on all joints.
15. Contractor shall obtain a signed statement from kitchen Contractor verifying ceiling height and hood configuration prior to hood ductwork fabrication.
16. Provide acoustic duct where indicated on the plans.
17. All exposed ducts shall be spiral.
18. Quick fit duct shall be used where called out on the plans or as called out in specialty exhaust specifications (i.e. 23 35 13 Sawdust Collection System).
19. Provide duct transitions to equipment openings.

B. Duct Liner:

1. Adhere insulation to sheet metal with full coverage of a UL listed adhesive.
2. Secure insulation with mechanical liner fasteners as indicated by SMACNA or manufacturer. Pin length should be as recommended by the liner manufacturer.
3. All exposed edges of the fibrous type liner must be factory or field coated. For systems operating at 4000 fpm or higher, a metal nosing must be installed in all liner leading edges.
4. Repair fibrous type liner surface penetrations with UL listed adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
6. Provide duct liner for all return air ducts unless specifically excluded in Section 23 07 13.01.
7. Provide acoustic duct liner for duct indicated on plan and Section 23 07 13.01.
8. Provide liner for all supply duct unless specifically excluded from Section 23 07 13.01.
9. Provide ductliner for first 10' in and out of all exhaust fans (excluding dishwasher, kitchen fume, and particulate fans).

C. Turning Vanes:

1. Install turning vanes in all square duct turns, and at locations shown on drawings.
2. Securely attach turning vane runners to ductwork.

D. Flexible Connections: See Section 23 33 00.01 - HVAC Specialties.

E. Dampers:

1. Provide each take-off with an adjustable volume damper to balance that branch.
2. Anchor dampers securely to duct.
3. Install dampers in main ducts within insulation.

4. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
 5. Install motorized dampers.
 6. Motorized dampers shall be installed in all outside air intakes, exhaust outlets, and relief outlets per WSEC and as shown on drawings.
- F. Grilles, Registers, and Diffusers: Install and anchor securely.
- G. Adjustable Lock Splitter Dampers:
1. Dampers in equipment rooms shall be complete with locking quadrant.
 2. Other dampers shall have concealed ceiling damper regulator with plate.
- H. Painting of Ductwork: Paint ductwork visible through registers, grilles, and diffusers flat black.
- I. Ductwork Leakage Criteria:
1. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined on page 1-6 of the 1985 SMACNA Manual, First Edition.
- J. Duct Cleanliness Criteria: Unless otherwise specified, the delivery, storage, and installation of all un-lined ductwork shall comply with the intermediate duct cleanliness level of SMACNA Duct Cleanliness for New Construction Guidelines. All lined and acoustic duct shall comply with the advanced level.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Requirements”
 - 2. Section 23 31 13.01 – “Steel Ductwork”

1.02 SUMMARY

- A. Includes, but not limited to, furnishing and installing specified material as described in Contract Documents.
- B. Filters used in air handling units and heat pumps.
- C. Flexible ductwork from supply air branch duct runouts to diffusers where indicated on drawings.
- D. Furnishing and installing fire dampers, ceiling radiation, and fire/smoke dampers at penetrations of fire rated walls, floors, and ceiling membranes, at ducts, registers, grilles, or louvers as indicated on drawings. Installation shall be complete with sleeves, angles, and all other accessories as required by UL installation instructions, local codes, and reviewing authorities.
- E. Section Includes:
 - 1. Backdraft dampers.
 - 2. Filters and filter housing.
 - 3. Flexible connections.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Backdraft dampers
- B. Filters
- C. Filter housing
- D. Air filter gauge
- E. Flexible ductwork
- F. Flexible equipment connections
- G. Duct smoke detectors

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Backdraft dampers
- B. Filters (Summary list including equipment tag and size and quantity of filter per unit.)
- C. Duct smoke detectors

1.05 QUALITY ASSURANCES

- A. Requirements of Regulatory Agencies:
 - 1. Bear the AMCA seal and UL label, NSF approved.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 BACKDRAFT DAMPERS (COUNTER BALANCED)

- A. General: 0.125 inches extruded aluminum frame, 0.07 inches aluminum blades with extruded vinyl edges, synthetic bearings, counterbalance, adjustable zinc plated bar on blades.
- B. Backdraft dampers are to be factory set to open at 0.01" w.c. of building pressure and shall have a maximum static pressure drop of 0.05" w.c. at 700 fpm per AMCA Standard 500. Backdraft dampers shall have a leakage rate at no more than 20 CFM/sq. ft. at 1" w.c. of static pressure with a dimension of 24" or greater and 40 CFM/sq. ft. at 1" w.c. of static pressure with dimension smaller than 24" per AMCA Standard 500D.
- C. Approved Manufacturer:
 - 1. Ruskin
 - 2. Greenheck

2.03 FILTERS

- A. 2" MERV 8:
 - 1. General: 30% efficient filters as specified herein shall be medium efficiency, pleated panel type, disposable filters; Farr 30/30 or approved and shall have an average efficiency of 25-30% atmospheric and 90-92% arrestance by ASHRAE Standard 52-76 unless instructed otherwise.
 - 2. Filter Housings: Shall be sized to fit furnished unit or duct to be installed in and provide minimum filter sizes to obtain a maximum filter velocity of 300 fpm.
 - 3. Resistance: Initial resistance of a 24"x24"x2" filter handling 2000 CFM shall not exceed 0.31" w.g.
 - 4. Duct Holding Capacity: Shall be no less than 60 grams per square foot of face area at 1.0" w.g.
 - 5. Size: Filters shall be 2" deep (unless indicated otherwise), with number and sizes indicated, or as required to give minimum nominal face area as scheduled on drawings.
 - 6. Provide a filter pull strap for all multiple filter sets longer than 24 inches.
 - 7. Approved Manufacturers:
 - a. Farr Co.
 - b. Airguard
 - c. Purolator
 - d. Eco-Air

2.04 TEMPORARY AIR INLET FILTERS

- A. Type: Glass fiber or synthetic material blanket type filter media. Inlets and outlets shall be MERV 8 and unit shall be same as final.
- B. Capacity: Shall have an average arrestance no less than 64%; dust holding capacity of 172 grams.

- C. Size: Minimum 1" thick cut to size as required to cover inlets.

2.05 FLEXIBLE DUCTWORK

- A. Formable, flexible, circular duct shall have a fiberglass scrim (or equivalent) and retain its cross-section, shape, rigidity, and shall not restrict air flow after bending.
- B. Normal 1-1/2 inches thick, 3/4 lb/cu ft density fiberglass insulation with airtight, see-through polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
- C. Assembly including insulation and vapor barrier, shall meet Class 1 requirements of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
- D. Approved Manufacturers:
 - 1. Wiremold
 - 2. Flexible Air Movers Inc.
 - 3. J.P. Lamborn
 - 4. General Flex Corp.
 - 5. Young & Co. Mfg 165
 - 6. Thermaflex 'GKM'
 - 7. Cleavaflex

2.06 FLEXIBLE EQUIPMENT CONNECTIONS

- A. General: 30 oz. closely woven UL approved glass fabric, double coated with neoprene. Fire retardant, waterproof, airtight, resistant to acids and grease, and withstand constant temperatures of 250°F.
- B. Approved Manufacturers:
 - 1. Ventglas by Ventfabrics
 - 2. DuroDyne MFN

2.07 DUCT SMOKE DETECTORS

- A. General: Smoke detectors shall be installed in supply duct within 4'-0" of each air handler of 2000 cfm and above.
- B. Responsibility: This Contractor shall be responsible for control circuit from smoke detectors to fan starter and to remote test station.
- C. Equipment: Detectors shall be "Notifier" DH400 series with sampling tube. Remote test station shall be "Notifier" RTS 451.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Backdraft Dampers: Provide access doors to backdraft dampers.
- B. Filters and Filter Housing:
 - 1. Contractor to install temporary filters to provide temporary sealing of all duct systems during the construction period to prevent the entry of dirt, dust and debris into the duct systems. These systems that are operated during the construction period shall have temporary filters installed over all inlets and filters installed in the air handling equipment. Filters installed in equipment shall be same type as final filters required for the units. Temporary air inlet type filters shall be taped over all inlets to completely filter all air drawn into the systems.
 - 2. Contractor to provide and install four (4) complete sets of all filters as scheduled below:
 - a. At equipment start-up.
 - b. Prior to balancing system.
 - c. Three (3) months after building occupancy.
 - d. During the one year warranty to be scheduled with Owner.
 - 3. Construct and install filter housings to prevent passage of unfiltered air. Provide sheet metal blanks, felt, rubber, and/or neoprene seals as necessary.
 - 4. Furnish Engineer with schedule of filter sizes for each air handler, heat pump, furnace, and fan coil unit.
- C. Flexible Equipment Connections:
 - 1. Provide insulated flexible equipment connections between ducts and vibrating equipment. Fans which are internally isolated with spring isolators do not require flexible connections, unless indicated on the plans.
 - 2. Install flexible connections with sufficient slack to permit 2 inches of horizontal or vertical movement of ducts or equipment at connection point without stretching the flexible material.
 - 3. Where installed exposed to weather, provide a galvanized "hat" channel protecting top and vertical stretches of flexible connector from sunlight and weather.
- D. Flexible Ductwork:
 - 1. Install duct in fully extended condition free of sags and kinks, using ten foot maximum lengths.
 - 2. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with 1/2 inch wide metal cinch bands and sheet metal screws. Tape exterior of flex to duct ahead of damper.
- E. Install duct smoke detectors in air handling units over 2000 CFM.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 20 00 00.01 – “General Mechanical Conditions”

1.02 GENERAL

- A. Includes, but not limited to, furnishing and installing specified material as described in Contract Documents.

1.03 QUALITY ASSURANCES (REQUIREMENTS OF REGULATORY AGENCIES)

- A. Bear AMCA seal, UL 507 (for continuous operation), and UL 705 (volume control by speed control on direct drive units).

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Exhaust Fans
- B. Fan curves showing system curve, and a fan curve with the maximum operation point with maximum motor size (limited by maximum shaft speed of and/or surge point).

1.05 OPERATION AND MAINTENANCE OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 ROOF MOUNTED (DOWN BLAST) EXHAUST FANS

- A. General:
 - 1. Direct drive or have adjustable pitch V-belt as noted on plans.
 - 2. Wheels shall be backward curved and housing shall be removable or hinged aluminum.
 - 3. Isolate motor with vibration dampeners.
 - 4. Provide quiet type back-draft dampers.
 - 5. Provide insulated pre-fabricated metal roof curb shall be for flat or sloped roof as required with 12" minimum height. Furnish with 4" wide flashing all around with cant strip.
 - 6. Fan shall be factory painted with acid resistant coating on fan exterior; color as selected by Architect.
 - 7. Approved Manufacturers:
 - a. Breidert
 - b. Carnes
 - c. Cook
 - d. Greenheck
 - e. Jenn

- f. Penn Barry
- g. Twin City Fans

2.03 IN-LINE FANS

A. General:

1. Motors on V-belt units shall be supported on the exterior of the fan casing with bearings encased within the fan tube.
2. All models shall incorporate a panel to permit access to interior.
3. Centrex wheels shall be backwardly inclined, non-overloading and made of aluminum.
4. Inlets shall be deep spun for non-turbulent entrance condition.
5. Approved Manufacturers:
 - a. Cook
 - b. Greenheck
 - c. Pace
 - d. Penn Barry
 - e. Twin City Fans

2.04 IN-LINE CABINET FANS

A. General:

1. Acoustically insulated housings.
2. True centrifugal wheels.
3. Suitable ground motors and mounts on rubber-in shear vibration isolators.
4. Motor and drive assembly shall be accessible through removable side panels.

B. Approved Manufacturers:

1. Carnes
2. Cook
3. Greenheck
4. Jenn
5. Penn Barry
6. Twin City Fans

2.05 CEILING MOUNTED EXHAUST FAN

A. General:

1. Acoustically insulated housings.
2. Include chatterproof integral back-draft damper with no metal contact.
3. True centrifugal wheels.
4. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.

5. Suitably ground motors and mount on rubber-in shear vibration isolators.
6. Provide roof cap or wall cap as required.
7. Provide "Architectural deluxe" metal grille.

B. Approved Manufacturers:

1. Penn Barry
2. Cook
3. Greenheck
4. Twin City Fans

2.06 SPEED CONTROL

- A. Use manufacturer's recommended speed control, which varies speed from 50 to 100% of full speed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Anchor fan units securely to structure or curb.
- B. Extend all internal wiring to box on exterior of unit.
- C. Factory mount speed control on outside of case on in-line fans, including wall propeller fans, and underneath weather casing for rooftop fans.
- D. Grease hood exhaust fan. Up-blast discharge shall be a minimum of 40" from top of fan to roof. Provide with vented curb and replaceable grease termination receptor.
- E. Install motorized damper no closer than 12" from fan.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “General Mechanical Conditions”

1.02 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install complete, all air terminals described in Contract Documents.
 - 2. Ceiling diffusers with damper.
 - 3. Louvers connected to ductwork.
 - 4. Roof hoods.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Grilles, registers, and diffusers
- B. Louvers
- C. Wall caps
- D. Roof hoods

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 GRILLES, REGISTERS AND DIFFUSERS (GRD)

- A. Shall be as scheduled on drawings.
- B. Provide the various grilles, registers and diffusers shown on the plans and of the various types herein before specified. All terminals with prime-coat finish shall be installed before the walls and ceiling is painted, in order that they may be finish painted by the General Contractor. Those with factory finish or aluminum construction shall be installed after the walls and ceilings are painted. All air terminals located in shower, toilet rooms, locker and dressing rooms shall be of aluminum construction w/baked off-white finish. All other Air Terminals shall be of a standard steel construction; wall-mounted terminals shall be prime coat finish; ceiling diffusers, exhaust and return air terminals shall have factory-applied baked enamel finish, color as selected by Engineer.
- C. Approved Manufacturers: (subject to submittal approval):
 - 1. Anemostat
 - 2. Nailor
 - 3. Kees
 - 4. Krueger

5. Price
6. Titus
7. Tuttle & Bailey
8. Shoemaker (except 700MA)

2.03 LOUVERS

- A. Provide stationary type with 4" frame, drainable blades, and aluminum bird screen. Frame and blade shall be 6063-T-5 aluminum alloy. Blades shall be at 37.5° angle and supported by hidden mullions. Intermediate support mullions shall not interrupt blade exterior appearance. Louvers shall receive finish color coating of modified fluoropolymer baked enamel following cleaning and pretreatment of metal. A 50% Kynar resin shall provide approximately 0.3" total dry film thickness when baked at 450°F. Color shall be as selected by the Engineer. Provide appropriate frame type for installation type.
- B. Louvers shown are minimum sizes for airflow requirements. Refer to Architectural elevations for exact size and location of louvers. This contractor is to provide full size louver as shown on the plans or Architectural elevations (whichever is larger), including but not limited to: hidden mullions, louver extensions, and louver shapes. Any louver area not used for ductwork shall be blanked off with sheet metal. The General Contractor to provide insulation for blanked off sections.
- C. Louver performance shall be as follows:
 1. Maximum S.P. drop of 0.15" at 800 ft./min.
 2. Minimum beginning point of water penetration at 0.01 oz/sq. ft. is 800 feet per minute (48"x48" size at 15 minute test period).
 3. Minimum AMCA rated free area of 54% (48"x48" size).
 4. Approved Manufacturers:
 - a. Ruskin (ELF 375DX)
 - b. American Warming
 - c. Wonder Metals
 - d. Greenheck
 - e. Metal Form
 - f. United Enertech

2.04 WALL CAPS

- A. Wall caps shall be constructed of extruded aluminum, with bird screen, sizes and model numbers as indicated on plans.
- B. Dryer vent caps shall be of aluminum construction with integral backdraft damper. Nutone No. 885 or approved.

2.05 MISCELLANEOUS

- A. Bird Screen: 1/2-inch mesh, constructed of either 0.051-inch aluminum wire or 19 gauge galvanized steel wire.
- B. Insect Screen: 14 x 18, 0.009" galvanized steel mesh.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The interior of duct connection including opposed blade damper and all visible duct interiors at connection shall be painted matte black.
- B. Each air terminal shall be installed with a spun rubber gasket between the flange and the frame or wall.
- C. Each air terminal with flexible duct connection shall have a square-to-round transition adapter box.
- D. Anchor securely into openings.
- E. All air terminals that supply air, which are not required to have an OBD, shall be provided with a volume damper.
- F. Provide round neck to flex duct reducers as required.
- G. Provide bird screened openings (1/2" mesh) on all duct openings where indicated and where openings do not have grilles or registers.
- H. All outlet and inlets exposed to the weather shall be adequately flashed and installed in a manner to assure complete weatherproofness.
- I. Provide blank-off panels on louver portion not connected to a duct. Blank-off panels to be painted flat black.
- J. Install louvers level and plumb.
- K. Secure louver frames in openings with concealed fasteners.
- L. Provide insect screen where indicated on drawings.
- M. Install roof caps in accordance with manufacturer's recommendations.
- N. Provide louvers with motorized dampers on all ductless, through wall relief penetrations unless otherwise noted on the drawings.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SUMMARY

- A. Includes But Not Limited To: Furnish and install material as described in Contract Documents.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Roof caps

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Cook
- B. Penn Ventilator
- C. Greenheck

2.02 FABRICATION

- A. Manufactured of extruded aluminum complete with roof curb to fit slope of roof and have minimum 12" height.
 - 1. 1/2 inch mesh 16 gauge aluminum bird screen.
 - 2. Units shall be factory prime coated to be field painted. Coordinate with General Contractor to field paint; color selected by Architect.
 - 3. Size: Roof vents shall have throat size as shown on the drawings.
 - 4. Dampers: Dampers shall be gravity, counter-balanced, or motorized.
 - 5. Provide 4" wide flashing all around, with cant strip.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with Manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 20 00 00.01 – “Mechanical General Requirements”
 - 2. Section 23 33 00.01 – “HVAC Specialties”

1.02 SUMMARY

- A. Includes, but not limited to, furnishing and installing packaged units as shown on Contract Documents.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Air-Cooled Condensing Unit Section shall be rated according to ARI Standards.
 - 2. Air delivery of units certified in accordance with standard test code for centrifugal fans adopted by AMCA.
 - 3. All units shall be designed for outdoor use.
- B. Requirements of Regulatory Agencies: Each unit shall be UL labeled.

1.04 WARRANTY

- A. This Contractor shall warrant the systems to be free from defects in material, equipment and workmanship under normal use and service and any time within one (1) year from date of final acceptance, with repair or replacement without cost to the Owner, any material, equipment or workmanship found to be defective. The date of final acceptance shall be recorded on a warranty certificate for each unit. The certificate is to be included in Operation & Maintenance Manual.
- B. All systems and control equipment shall be inspected and serviced or adjusted as required for optimum and satisfactory performance a minimum of four (4) times during the next twelve (12) months after the date of final acceptance. The first inspection shall be made approximately thirty (30) days after final acceptance and the final inspection shall be made during the eleventh month thereafter.

1.05 REFERENCES

- A. ARI 210/240 - Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

1.06 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Carrier
- B. Lennox
- C. Trane

2.02 MANUFACTURED UNITS

- A. General: Units shall be completely factory assembled and tested and fully charged with non-ozone depleting refrigerant. Units shall include the following:
 - 1. Refrigerant Coils
 - 2. Condenser Fans and Motors
 - 3. Interconnected Wiring
 - 4. Prewired Control Panel
 - 5. Filter Section. Also, see Section 23 33 00.01 HVAC Specialties.
 - 6. Factory installed 100% modulating economizer cycle including motorized dampers, controls. Include barometric relief or powered relief as noted on schedule.
 - 7. Corrosion resistant, all-weather cabinet with down flow through curb configuration.
 - 8. Unit shall have an efficiency rating equal to or better than that scheduled.
 - 9. Cooling units shall be operable down to 35°F outdoor temperature.
 - 10. Heat pump unit shall be operable down to 0°F outdoor temperature.
 - 11. Supplemental Electric Heaters
- B. Refrigerant Coils: Constructed of copper tubes with mechanically bonded aluminum plate fins.
- C. Cabinets: Galvanized, weatherproof and coated inside and outside with corrosion-resistant paint.
- D. Roof Curb: Shall be factory furnished to mate with unit. Curb height not to exceed 14 inches.
- E. Refrigerant shall meet the latest EPA requirements.
- F. Powered exhaust shall be available on units above 5 tons. The accessory shall assist the barometric relief damper in the economizer in relieving building pressurization.
- G. Air-Cooled Condensing Unit Section:
 - 1. Unit shall contain a strainer-dryer.
 - 2. Furnish unit with time delay or cycle protection to prevent short cycling.
- H. Compressor:
 - 1. Hermetic or semi-hermetic type mounted on vibration isolators.
 - 2. Equip with crankcase heater.
- I. Condenser Fan: Axial flow type propeller fan.
- J. Refrigerant Lines: Shall have:
 - 1. Flexible connections.
 - 2. Suction and liquid line service valves.
- K. Fan Section:
 - 1. Centrifugal Fan - One or more.
 - a. Double inlet.
 - b. Double width forward curved Class I.

- c. Constructed and tested in accordance with AMCA requirements.
- L. Dampers:
 - 1. Motorized dampers shall be Class IA and have a leakage rate of no more than 4 cfm/sq.ft. at 1.0 inch w.g.
 - 2. Non-motorized dampers shall have a leakage rate of no more than 20 cfm/sq.ft. at 1.0 inch w.g.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide PVC P-trap on condensate discharge.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SUMMARY

- A. The ductless split system shall be a heat pump or air conditioning unit. The system shall consist of a wall mounted, ceiling suspended, horizontal ducted, or ceiling recessed evaporator section with wireless controller.

1.03 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with ARI Standard 210 and bear the ARI label.
- D. 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).

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.
- B. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105 ° F storage temperatures and 95% relative humidity.

1.05 WARRANTY

- A. The units shall have a manufacturer's warranty for a period of one (1) year from date of substantial completion as defined in Division 1. The compressor shall have a warranty of six (6) years from date of substantial completion. 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.

1.06 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- E. A dry air holding charge shall be provided in the indoor section.
- F. System efficiency shall meet or exceed 14.5 SEER when part of a 1:1 (indoor/outdoor) system.
- G. Delivery, Storage and Handling:
 - 1. Unit shall be stored and handled according to the manufacturer's recommendations.
 - 2. wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity.

1.07 SUBMITTAL REQUIREMENTS

- A. Indoor Unit
- B. Outdoor Unit

PART 2 - PRODUCTS

2.01 INDOOR UNIT

- A. General: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit shall be charged with dry air before shipment from factory.
- B. Unit Cabinet:
 - 1. The casing shall have a white finish.
 - 2. Multi directional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining.
 - 3. There shall be a separate, metal back-plate that secures the indoor unit firmly to the wall.
- C. Fan:
 - 1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
 - 2. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.
 - 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 - a. 3.1 Indoor units shall have a "Wide Vane" feature to distribute airflow over a wide – 150 degree – angle from right to left to provide comfort over a wider area.
 - 4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down.
 - 5. The indoor fan shall operate at a minimum of (3) selectable speeds: High, Medium and Low.
- D. Filter:
 - 1. Return air shall be filtered by means of a cleanable or disposable filter.
- E. Coil:
 - 1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - 2. The tubing shall have inner grooves for high efficiency heat exchange.
 - 3. All tube joints shall be brazed with phoscopper or silver alloy.
 - 4. The coils shall be pressure tested at the factory.
 - 5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.
 - 6. A condensate mini-pump shall be provided to provide a means of condensate disposal when a gravity drain is not available.

7. An optional drain pan level switch (DPLS1), designed to connect to the control board, shall be provided if required, and installed on the condensate pan to prevent condensate from overflowing.

F. Electrical:

1. The unit electrical power shall be as scheduled on the drawings.
2. The indoor unit shall not have any supplemental electrical heat elements.

2.02 CONTROL

A. General:

1. The unit shall have a wireless controller to perform input functions necessary to operate the system.
2. The wireless controller shall have a Power On/Off switch, Mode Selector – Cool, Dry, Heat, Auto Modes - Temperature Setting, Timer Control, Fan Speed Select and Auto Vane selector.
3. The indoor unit shall perform Self-diagnostic Function and Check Mode switching.
4. Temperature changes shall be by 1°F increments with a range of 59 - 89°F.
5. 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.
6. The system shall be capable of automatically restarting and operating at the previously selected conditions when the power is restored after power interruption.
7. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off, System/Mode function.
8. The indoor unit shall have a wireless remote controller.

2.03 OUTDOOR UNITS

- A. General: Outdoor units shall be specifically designed to work with the indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.

C. Fan:

1. The unit shall be furnished with a direct drive propeller type fan.
2. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.
3. The fan motor shall be mounted for quiet operation.
4. The fan shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have horizontal discharge airflow.

D. Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil shall be protected with an integral metal guard.
3. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

E. Compressor:

1. The compressor motor shall be direct current (DC).
2. The compressor shall be a high performance hermetic; inverter driven, variable speed, dual rotary type.
3. The outdoor unit shall have an accumulator.
4. The compressor will be equipped with an internal thermal overload.
5. The outdoor unit must have the ability to operate over the full range with a maximum height difference of 50 feet and have refrigerant tubing length of 100 feet between indoor and outdoor units.
6. There shall be no need for line size changes, traps shall not be used, and no additional refrigerant oil shall be required.
7. The compressor shall be mounted so as to avoid the transmission of vibration.

F. Electrical:

1. The unit electrical power shall be as scheduled on the drawings.
2. The outdoor unit shall be controlled by the microprocessor located in the indoor unit and outdoor unit.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install units in locations shown on plans and in accordance with manufacturer's instructions.
- B. Piping: Insulate refrigerant piping according to Section 23 07 19.01. Provide condensate piping to unit. Condensate line shall drain to the nearest drainage point or where indicated on plans.
- C. Unit Protection: Units shall be protected during construction to prevent debris from depositing on the unit per Section 20 00 00.01.
- D. Horizontal Units:
1. Pitch units towards condensate drain outlet to facilitate condensate drainage.
 2. Support hung units with hangers, rods, and manufacturer furnished clips and vibration isolators.
- E. Vertical Units: Install units on isolator pad to minimize vibration transfer to structure. Large vertical units shall be installed on external rubber type vibration isolators.

3.02 START-UP

- A. Initial Checks: Prior to operating units, checks shall be made to insure that adequate voltage, duct connections, electrical connections, control connections, and other items as listed by the manufacturer are properly provided/connected and operating to insure safe and proper unit operation.
- B. Testing and Adjustment: Operate unit in various modes of operation to test for proper operation, including fan rotation, proper damper travel (where applicable), proper cooling/heating, correct interface to other controls (time clock, fans, etc.). Make necessary adjustments per manufacturer's directions.
- C. Final Check: When testing and adjustment is complete, a final check of each unit shall be done by the manufacturer's authorized service representative to verify proper unit operation.
- D. Start-Up Log: Provide a start-up log per Section 23 23 00.01 - Refrigerant Piping System.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:

- 1. Section 20 00 00.01 – “General Mechanical Requirements”

1.02 SUMMARY

- A. Includes but not limited to: Furnishing and installing specified material as described in the Contract Documents.

1.03 QUALITY ASSURANCE

- A. Units to be UL listed.
- B. Shall conform to NEC and NFPA requirements.

1.04 OPERATION AND MAINTENANCE REQUIREMENTS OF THIS SECTION

- A. Not Applicable

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Not Applicable

2.02 FAN FORCED WALL HEATERS

- A. Provide recess mounting in stud wall and surface mounting in block wall unless otherwise stated on plans.
- B. 20-gauge minimum sheet metal casing.
- C. Heating element shall be encased in steel finned casting and protected by thermal switch.
- D. Fan motor shall be heavy duty enclosed and permanently lubricated.
- E. Fan shall be precision balanced and fan motor assembly mounted to be vibration free.
- F. Units shall be controlled automatically by integral thermostat when heater is in “ON” position unless otherwise stated on plans.
- G. Heater shall have built-in fan delay.
- H. Finish shall be baked-on enamel.
- I. Bi-metallic limit turns the element off when an over temperature condition occurs. Automatically resets when the normal temperature returns.
- J. Approved manufacturer:
 - 1. Berko
 - 2. King
 - 3. Markel

PART 3 - EXECUTION

3.01 NOT APPLICABLE

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. By submitting a bid, the Contractor is acknowledging that he has made a thorough examination of the Contract Documents, existing site and building conditions, and has determined that these documents do sufficiently describe the scope of construction work required under this Contract.

1.03 SCOPE OF BASIC BID

- A. Included in Division 26 work is all work and related items necessary to provide all electrical installations except as specifically excluded. In general, this includes all labor, equipment, tools, etc., to complete the electrical work.

1.04 STANDARDS AND REGULATIONS

- A. The work shall comply with the latest edition of the applicable Standards and Codes of the following:

ASTM	American Society for Testing and Materials
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
---	State Electrical Code
NESC	National Electrical Safety Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
U.L.	Underwriters Laboratories Inc.
IPCEA	Insulated Power Cable Engineers Associated
CBM	Certified Ballasts Manufacturers
---	Federal, State and Local Building Codes
ETL	Electrical Testing Laboratories

- B. If any conflict occurs between Government adopted Code Rules and this specification, the codes are to govern. Nothing in these drawings and specifications shall be construed to permit work not conforming with governing codes. Also, this shall not be construed as relieving the Contractor from complying with any requirements of the plans and specifications which may be in excess of, but not in conflict with, requirements of the Governing Codes.

1.05 PERMITS & FEES

- A. The Contractor shall obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. The Contractor shall arrange for inspection of work by the inspectors and shall give the inspectors all necessary assistance in their work of inspection.
- B. The Contractor shall consult with and follow the requirements of the local fire, power, telephone, and television utilities serving the area and shall coordinate his work with them.

1.06 INTENT OF DRAWINGS

- A. The electrical drawings are intended to serve as working drawings for general layout. The equipment layout is diagrammatic and unless specifically dimensioned or detailed, does not indicate all fittings, hardware or appurtenances required for a complete operating installation.
- B. Anything shown on the drawings but not covered in the specifications, or anything covered in the specifications but not shown on the drawings, shall be as if covered in both. In case of conflict between the drawings and specifications, the Engineer will select the method to be used. The Contractor shall be responsible for verifying all measurements before proceeding with the work.
- C. Wiring diagrams are not intended to indicate the exact course of raceways or exact location of outlets. Raceway and outlet locations are approximately correct and are subject to revision as may be necessary or desirable at the time of installation. Precise location in every case shall be subject to the Engineer's approval.

1.07 PROTECTION

- A. The Contractor shall store and guard all equipment before installation and shall protect same, and replace any equipment that has been damaged prior to final acceptance.

1.08 HOUSEKEEPING

- A. All electrical materials shall be kept stored in an orderly fashion protected from heat, cold, and the weather.
- B. All marred surfaces shall be refinished and painted after installation.
- C. All debris shall be removed from premises during work, as directed, and at completion of job.

1.09 TEMPORARY USE

- A. Temporary or interim use of any and all portions of the electrical system shall be under the supervision of the Electrical Contractor.
- B. Temporary power and lighting for use during construction shall be provided per the requirements of the Division 01 specifications.

1.10 WARRANTY

- A. Provide a written warranty that the Division 26 work is free from mechanical and electrical defects. Contractor shall replace and repair, to the satisfaction of the Engineer, any parts of the installation which may fail within a period of 12 months after the certificate of final acceptance provided that such failure is due to defects in material or workmanship, or failure to follow the specifications and drawings.
- B. See Section 27 00 00.01 for additional requirements of low voltage systems.

1.11 INSTRUCTION PERIODS

- A. Upon completion of the work and after all tests and final inspection of the work by the authority(s) having jurisdiction, the Contractor shall demonstrate and instruct the Port's designated operation and maintenance personnel in the operation and maintenance of the various electrical systems. The Contractor shall arrange scheduled instruction periods with the Engineer. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system and suppliers representatives when so specified.
- B. Scheduled Instruction periods shall be:
 - 1. Low Voltage Lighting Control Systems 1/4 day

2. Fire Alarm System 1/2 day
3. Daylighting Control Systems 1/4 day

C. Costs for time involved by Contractor shall be included in the bid.

1.12 COMPLETION OF WORK

- A. Upon completion of the Division 26 work, the Contractor shall deliver to the Engineer a completion letter stating that he has fulfilled all the requirements of his Contract for Division 26 work as set forth in the drawings and specifications and that all items in pre-final inspection lists submitted by the Engineer have been satisfactorily completed.
- B. Arrange for and obtain all required inspections and certificates pertaining to the Division 26 work and deliver the certificates to the Engineer.
- C. Prior to or at the time of final inspection, the Contractor shall, as outlined in detail in the specifications, complete the delivery of all the following items:

1. Completion Letter
2. Certificate of Final Inspection, in triplicate form.

Electrical Inspector

COMPLETION OF WORK

3. Warranty to Port (with copy for Engineer SUPPLEMENTARY GENERAL CONDITIONS

26 00 00.01- 1.10

4. Phase Current Readings GENERAL, TESTS

26 05 19.01 – 3.03 (E)

5. OHMIC Test Readings GENERAL, TESTS

26 05 19.01 – 3.03 (B)

6. Certificate of Feeders Torque Results WIRES AND CABLES

26 05 19.01 – 3.03 (I)

7. * Receipt from person to whom delivered LIGHTING FIXTURES
the following spare glasses, plastic diffusers,
lamps, and ballast fuses. 26 50 00.01

8. * Receipt from person to whom delivered LOW VOLTAGE – 27 00 00.01 the
following: Spare Elements for Fire
Detectors, Fuses for Switches, Spare Keys FIRE ALARM – 28 31 00.01 for
Panelboards, receptacles switches, plugs, etc.
FUSES – 26 28 13.01

PANELBOARDS – 26 24 16.01

SWITCHES & RECEPTACLES –
26.01

26 27

* Secure delivery instructions from Engineer for delivery to Port.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials must be of the quality herein specified. All materials shall be new, of the best quality and free from defects. They shall be designed to ensure satisfactory operation and operational life in the environmental conditions which will prevail where they are being installed.
- B. Each type of material shall be of the same make and quality. The materials furnished shall be standard products of the manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
- C. All materials shall be U.L. or E.T.L. listed for the purpose for which they are used.
- D. Equipment in compliance with U.L. standards but not bearing their label is not acceptable. If the manufacturer cannot arrange for labeling of an assembled unit at the factory the unit shall be field evaluated per the Washington State Administrative Code (WAC) and the electrical inspector's requirements.

2.02 COMPLETE SYSTEM

- A. All the systems mentioned shall be complete and operational in every detail except where specifically noted otherwise. Mention of certain materials in these specifications shall not be construed as releasing the Contractor from furnishing such additional materials and performing all labor required to provide a complete and operable system.

2.03 NAMEPLATES

- A. Provide nameplates constructed of plastic (black on white) laminated material engraved through black surface material to white sublayer (attach with screws on NEMA 1 enclosures). EXCEPTION (1): Emergency distribution system component labeling - white letters on red background. Exception (2): Series rated systems shall be yellow background with white letters.
 - 1. Service Entrance Label: Refer to Section 26 24 13.01
 - 2. Panelboard Labels: Refer to Section 26 24 16.01
 - 3. Switch and Receptacle Labels: Refer to Section 26 27 26.01
 - 4. Motor Starter and Disconnect Labels: Refer to Section 26 28 16.01

PART 3 - EXECUTION

3.01 GENERAL

- A. Careful consideration shall be given to clearances under and over beams, pipes and ducts, to provide proper headroom in all cases. Check drawings to determine heights of all suspended ceilings and size of pipe shafts where raceway and wire-ways shall run. Coordinate installation of Division 26 wiring and equipment with Division 23 and other trades. Where insufficient room for proper installation appears, obtain clarification from Engineer before any installation is begun.
- B. Cutting and Patching:
 - 1. Obtain permission from the Engineer prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills except where space limitations prevent the use of such drills.

2. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.02 COORDINATION

- A. The Contractor is responsible for accomplishing Division 26. The work shall coordinate with that of the other Contractors and/or other trades doing work in the building and shall examine all Drawings, including the several Divisions of Mechanical, Structural, Civil and Architectural, for Construction Details and necessary coordination. Specific locations of construction features and equipment shall be obtained from the Contract Documents, field measurements, and/or from the trade providing the material or equipment. No extra costs will be allowed for failure to obtain this information.
- B. All conflicts shall be reported to the Engineer in writing before installation for decision and correction. Special attention is called to the following items:
 1. Door swings to the end that switches will be located on "Strike" side of the door.
 2. Location of grilles, pipes, sprinkler heads, ducts and other mechanical equipment so that all electrical outlets, lighting fixtures and other electrical outlets and equipment are clear from and in proper relation to these items.
 3. Location of cabinets, counters, and doors so that electrical outlets, lighting fixtures and equipment are clear from and in proper relation to these items.
 4. Type and height of ceiling.
 5. All device measurements referenced on drawings or specifications are to be centered of device unless noted otherwise.
- C. The Contractor will not be paid for work requiring reinstallation due to lack of coordination or interference with other Contractors or trades. This includes, but is not limited to, removing, replacing, relocating, cutting, patching, and finishing.
- D. Device and fixture locations may be changed within 15 feet without extra charge if so desired by the Engineer, before installation.

3.03 CLEANING AND PAINTING

- A. All equipment, whether exposed to the weather or stored indoors shall be covered to protect it from water, dust and dirt.
- B. After installing, all metal finishes shall be cleaned and polished, cleaned of all dirt, rust, cement, plaster, grease and paint.
- C. All equipment with a primer coat of paint shall be given two (2) or more coats of a finish enamel and scratched surfaces be refinished to look like new. Markings, identification and nameplates shall be replaced.

3.04 EQUIPMENT IDENTIFICATION

- A. Provide identifying engraved bakelite nameplate on all equipment, including pull boxes, to clearly indicate its use, area served, circuit identification, voltage, and any other useful data.
- B. Each auxiliary system, including communications, shall be clearly labeled to indicate its function.

3.05 DEVIATION

- A. Deviation from the shop drawings in construction or installation of equipment shall not be made unless Shop Drawings showing proposed deviations are submitted to and approved by the Engineer. If any equipment is furnished under this or other divisions with current, voltage or phase ratings that differ from those shown on the drawings, the Contractor shall notify the Engineer in writing immediately and shall not connect said equipment until instructed as to required changes by the Engineer. No extension of time will be granted as a result of such changes.

3.06 EXCAVATIONS

- A. All excavations are to be so conducted so that no walls or footings shall be disturbed in any way.
- B. Remove all surplus earth not needed for backfilling and dispose of same as directed.

3.07 WIRING METHODS

- A. All low voltage wiring shall be in Raceway with Junction Boxes and Fittings where concealed in walls, in inaccessible ceiling space, or where exposed in finished or unfinished areas.
- B. All branch circuit wiring shall be installed in raceway with junction boxes and fittings.
- C. Provide access panels as needed for pull boxes and equipment located above ceiling or behind walls.
- D. Any low voltage cables that are not terminated at both ends shall be tagged and labeled per code.
- E. See Section 27 00 00.01 for additional requirements of low voltage systems.

3.08 PENETRATIONS OF FIRE RATED ELEMENTS

- A. Must be made such as to retain that rating.

3.09 HANGERS AND SUPPORTS

- A. Provide hangers, brackets, and suspension rods and supplementary steel to support equipment.
- B. Hangers provided under other divisions shall not be used for support of Division 26 equipment unless permitted by the Engineer.

3.10 CHASES AND OPENINGS

- A. Provide to the masonry and concrete trades all templates and details of chases, openings in floors and walls as required for Division 26 equipment installation.

3.11 WORKMANSHIP AND OBSERVATION

- A. Workmanship shall be of the best quality and none but competent workers shall be employed under the supervision of a competent foreman. All completed work shall represent a neat and workmanship like appearance.
- B. All work and materials shall be subject to observation at any and all times by the Engineer.

3.12 MISCELLANEOUS

- A. Provide complete seismic anchorage and bracing for the lateral and vertical support of conduit and electrical equipment, as required by the International Building Code.

- B. Conduits that cross seismic separations shall be installed with flexible connection suitable to accommodate conditions. Secure raceways on each side of a separation and provide a minimum of 36" length of flexible conduit to span separation.

3.13 CABLE AND WIRING ROUTED UNDERGROUND OR UNDERSLAB

- A. All cables and conductors, both line voltage and low voltage, routed underground or underslab shall be U.L. listed for installation in wet locations per NEC and WAC codes.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide all wire, cable, and terminations complete.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. All wire types and cables.
- B. Splices
- C. Terminations
- D. Plastic Cable Ties

PART 2 - PRODUCTS

2.01 WIRE AND CABLE (COPPER, 600-VOLT)

- A. Interior and Above Grade: All wires to be Type THWN/THHN. Wire and cables shall be brought to project in original containers bearing the underwriters label.
- B. Underground: All conductors to be type USE. Increase Raceway size when necessary to accommodate conductors per code. Exception: Underground conductors completely contained in code recognized Raceway and boxes may be Type THW, THWN or XHHW.

2.02 SPLICES

- A. Above Grade: Solderless type only. Preinsulated "twist-on" type (limited to size #10 and smaller). Bolt on compression type with application of preformed insulated cover, heat shrinkable tubing or plastic insulated tape acceptable for all sizes.
- B. Below Grade: Splices below grade shall be in handholes and shall be made watertight with epoxy resin type splicing kits similar to Scotchcast.

2.03 TERMINATIONS

- A. Compression set, bolted or screw terminal.
- B. Conductors #12 and smaller shall utilize eye or forked tongue type compression set terminator utilizing ratchet type compression style when termination is to a bolted or screw set type terminal block or terminal cabinet.

2.04 PLASTIC CABLE TIES

- A. Nylon or Equivalent, locking type.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all wiring in Raceway unless shown or specifically authorized otherwise.

3.02 WIRE SIZE

- A. No. 12 AWG minimum for power and lighting circuits.
- B. Provide solid wire for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger (600) volts.

3.03 TESTS

- A. In addition to the factory testing of all equipment and cable, the Contractor shall test all wiring connections for continuity and ground before any fixtures or other loads are connected. Tests shall be made with a 500V minimum DC "Megger" type tester. If tests indicate faulty insulation (less than 2 megohms), such defects shall be corrected and tested again. Contractor shall provide all apparatus to make tests and shall bear all expenses of required testing. Routine operation tests shall be made on all pieces of equipment to demonstrate that working parts are in operating condition. Results of all tests shall be recorded and submitted to the Engineer. The Contractor shall immediately replace all parts, which fail to pass the test.
- B. Measure the OHMIC value of the Electric Service Entrance metallic "System Ground" with reference to "Earth Ground" using the "Multiple Ground Rod Fall-In-Potential" method and suitable instruments. Maximum resistance to ground shall be less than 10 ohms. If this resistance cannot be obtained with the ground system shown, notify the Engineer immediately for further instructions. Provide OHMIC test results to Engineer.
- C. All circuits both in and out of the building shall test out free of grounds, short circuits and other defects.
- D. Check and record catalog number and ampere size of controller overload heaters installed, nameplate full-load amperes, and actual operating amperes of each motor. IMPORTANT: Submit recorded data in triplicate to the Engineer. Check proper load balance on the electrical system, direction of rotation, lubrication, and overload protection of all motors before placing in operation.
- E. Provide a log of ampere reading for all panels from phase to neutral for 4 wire panels and from phase to phase for 3 wire panels. These readings shall be taken with all loads activated.
- F. The final test of all equipment shall be made on dates designated by the Engineer and all readings shall be made in his presence.
- G. Feeders shall be checked to ensure all phases are energized before connecting to their respective motors. Each motor shall rotate in the proper direction for its respective load. Prior to rotation test, all bearings shall be inspected for proper lubrication.
- H. Minimum megger test for equipment shall be as follows:

Equipment Maximum	Minimum Test
Voltage Rating	Resistance
<hr/>	
1,000-Volts or less	2 Megohms
- I. Provide certification of torque values for feeder and service entrance conductors per equipment manufacturer's recommendation.

3.04 CONDUCTOR SIZES, REFERENCED ON PLANS

- A. Copper, type THWN/THHN unless noted.

3.05 PULLING

- A. Use no mechanical means for pulling No. 8 AWG conductors and smaller. Powdered soap stone or approved spray cream shall be the only lubricant used.

3.06 STRIPPING INSULATION

- A. Do not ring the cable, always pare or pencil.

3.07 TAPING

- A. If used shall be half lapped synthetic tape.

3.08 CONDUCTORS IN PANELS AND SWITCHBOARDS

- A. Conductors in panels, switchboards, and terminal cabinets shall be neatly grouped and formed in a manner to "Fan" into terminals with regular spacing.

3.09 CABLE SUPPORTS

- A. Provide conductor support devices as required by code in vertical cable runs.

3.10 RACEWAY SIZES REFERENCED ON DRAWINGS

- A. Raceways are sized for copper, type THW, unless otherwise noted. Size all Raceways per code unless specifically noted to be larger on the drawings.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. A grounding system shall be provided for neutral ground and equipment ground as required by code.
- B. An isolated grounding system shall be provided for all isolated ground receptacles as allowed by Code (2011 NEC 250-146, paragraph D).

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Grounding Conductors
- B. Ground Rods
- C. Isolated Ground Bars

PART 2 - PRODUCTS

2.01 GROUNDING CONDUCTORS

- A. Copper, code size, with physical protection where subject to damage. Bare or green insulated.

2.02 GROUND RODS

- A. 3/4" x 8'-0" copper clad steel.

2.03 ISOLATED GROUND BARS

- A. Provide in all panels containing isolated ground circuits.

PART 3 - EXECUTION

3.01 GENERAL

- A. Provide all grounding for electrical systems and equipment as required by codes and as specified herein.

3.02 GROUND RODS

- A. Provide as shown and/or required. Connect the ground conductor to each rod.

3.03 SIZE OF GROUND WIRE

- A. As required by code. Where ground wire is exposed to physical damage or is used outside of building, protect with conduit.

3.04 GROUND CONNECTION OF WATER PIPING

- A. Metal internal piping shall be grounded, as part of this Contract. This includes jumpers for dielectric fittings.

3.05 GROUND CONNECTION OF BUILDING STEEL

- A. Structural metal shall be grounded, as part of this Contract.

3.06 CONNECTION TO THE GROUND BUS

- A. Provide connections in accordance with the codes; including but not limited to raceway systems, switchboard/panelboard frames, service neutral, separately derived systems,

electrically operated equipment and devices. No device or equipment shall be connected for electrical service which has a neutral conductor connected to a grounding conductor or to the frame within the device or equipment.

3.07 METHOD OF CONNECTION

- A. Make all ground connections and ground cable splices by thermal welding. Grounding lugs, where provided as standard Manufacturer's items on equipment furnished, may be used.

3.08 FLEXIBLE RACEWAY

- A. Shall not be used for grounding. Install separate ground conductor in all flexible raceway.

3.09 PVC RACEWAY

- A. Install separate ground conductor in all PVC raceway as required per code.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide outlet and pull boxes to enclose devices, permit the pulling of conductors and for wire splices and branches.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Outlet and Pull boxes
- B. Concrete and Masonry boxes
- C. Ceiling outlet boxes

PART 2 - PRODUCTS

2.01 INTERIOR WIRING

- A. General: Outlet and pull boxes shall be pressed drawn steel, zinc coated with plaster ring where applicable. Welded boxes not allowed. Four-inch size minimum. Large pull boxes shall be fabricated sheet steel, zinc coated or baked enamel finish, with return flange and screw retained cover.
- B. Surface Metal Raceway: Boxes of same Manufacture and to match Raceway. Boxes to accommodate standard devices and device plate.
- C. Concrete and Masonry: Boxes for casting in concrete or mounting in masonry walls shall be the type specifically designed for that purpose.
- D. Install pull boxes so as to be accessible after completion of building construction.
- E. Ceiling outlet boxes shall be galvanized octagonal 4 inch, 1-1/2 inch deep (without fixture stud), 2-1/8 inches deep (with fixture stud).

PART 3 - EXECUTION

3.01 ANCHORING

- A. All boxes shall be firmly anchored directly or with concealed bracing to building studs or joints. Boxes must be so attached so that they will not "Rock" or "Shift" when devices are operated.

3.02 FLUSH MOUNTING

- A. Except for surface mounted boxes or boxes above accessible ceilings, all boxes shall have front edge (box or plaster ring) even with the finished surface of the wall or ceiling.

3.03 ELECTRICAL OUTLETS

- A. General: Coordinate the work of this section with the work of other sections and trades. Study all Drawings that form a part of this Contract and confer with various trades involved to eliminate conflicts between the work of this section and the work of other trades. Check and verify outlet locations indicated on Architectural Drawings, door swings, installation details, layouts of suspended ceilings and locations of all plumbing, heating and ventilating equipment.
- B. Centered on Built-In Work: In the case of doors, cabinets, recessed or similar features, or where outlets are centered between such features, such as between a door jamb and a cabinet, make these outlet locations exact. Relocate any outlets which are located off center.

- C. Vertical and Horizontal Relationships: Where more than one outlet is shown or specified to be at the same elevation or one above the other, align them exactly on centerlines horizontally or vertically. Relocate as directed all such outlets (including lighting, receptacle, power signal and thermostat outlets) which are not so installed, at no additional cost to Port.
- D. Device Outlet Height: Measure from the finished floor.
 - *Switches 4 Feet, Set Vertically, to Top of Box
 - *Receptacles, 18 Inches, Set Vertically to Centerline
 - Telecommunications
 - Other As Noted or as Directed by Engineer
 - * *Heights may vary. See Drawings for additional information*
- E. Ceiling Location: For acoustical material locate outlet either at the corner joint or in the center of a panel, whichever is closer to the normal spacing. Locate all outlets in the same room in the same panel location.
- F. Installed In Sound Walls: Boxes installed in sound walls shall not be installed back to back. All boxes shall be separated by one stud space and shall be interconnected with flex conduit with a 90° loop.

3.04 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK AND CASEWORK

- A. Provide as shown and/or specified. Provide templates, where required, to other trades for drilling and cutting to insure accurate location of electrical fixtures (outlets and devices) as verified with the Engineer. Provide all wiring, devices, plates and connections required by said fixture.

3.05 CONNECTION TO EQUIPMENT

- A. For equipment furnished under this or other Divisions of the Specifications, or by others. Provide outlet boxes of sizes and at locations necessary to serve such equipment. An outlet box is required if the equipment has pigtail wires for external connection, does not have space to accommodate circuit wiring used. Study equipment details to assure proper coordination.

3.06 BLANK COVERS

- A. Provide blank covers or plates over all boxes not covered by equipment.

3.07 JUNCTION OR PULL BOXES

- A. Pull and junction boxes shall be installed as shown, and to facilitate pulling of wire and to limit the number of bends within code requirements. Boxes shall be permanently accessible and shall be placed only at locations approved by the Engineer.
- B. In suspended ceiling spaces, boxes shall be supported from the structure independently from ceiling suspension system.
- C. The Drawings do not necessarily show every pull or Junction Box required. The Contractor is permitted to provide boxes deemed necessary by him for his work when installed in accordance with these Specifications.

3.08 BOXES CONTAINING MULTIPLE DEVICES

- A. Boxes containing emergency and normal devices are permitted only with steel barriers Manufactured especially for the purpose of dividing the box into two completely separate compartments.

- B. Device Boxes Containing Multiple Devices and Wiring Rated Over 150 Volts to Ground and Over 300 Volts Between Conductors are permitted only with steel barrier manufactured especially for the purpose of dividing the box into separate compartments for each device having exposed live parts.

3.09 BOXES IN EARTH

- A. Provide for all wire splices and as required to pull conductors. Boxes (handholes) shall be set in place on a 3" sand bed. Coverplates shall be flush to, and match the slope of, the final surface grade.

3.10 NAMEPLATES

- A. For all line voltage junction boxes, provide engraved nameplate indicating circuit numbering of all wiring in junction box.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide Raceway System complete.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. All proposed conduit type to be utilize for this project.
- B. Flexible Metal Conduit

PART 2 - PRODUCTS

2.01 GALVANIZED RIGID STEEL CONDUIT (GRS)

- A. General: Hot dipped galvanized.
- B. Fittings: Galvanized malleable iron or noncorrosive alloy compatible with galvanized conduit. Erickson couplings, watertight split couplings (O.Z. type or equivalent) permitted. Running thread or set screw type fittings not approved.

2.02 INTERMEDIATE METAL CONDUIT (IMC)

- A. General: Hot Dipped galvanized.
- B. Fittings: Galvanized malleable iron or noncorrosive alloy compatible with galvanized conduit. Erickson couplings, watertight split couplings (O.Z. type or equivalent) permitted. Running thread or set screw type fittings not approved.

2.03 ELECTRICAL METALLIC TUBING (EMT)

- A. General: Hot dipped galvanized.
- B. Fittings: Raintight; steel or malleable iron type using a split corrugated compression ring and tightening nut or stainless steel locking disc. Steel set screw fittings are acceptable for dry locations. Indenter, drive-on and pressure cast or die cast type set screw are not acceptable.

2.04 FLEXIBLE METAL CONDUIT (FMC, LFMC)

- A. Dry Locations:
 - 1. General: Galvanized flexible steel for dry locations only.
 - 2. Fittings: Malleable iron or steel, Thomas and Betts "squeeze" type or equal.
- B. Damp and Wet Locations:
 - 1. Liquid Tight: Polyvinyl chloride (PVC) weatherproof cover over flexible steel conduit.
 - 2. Fittings: Thomas and Betts "liquid tight" or equal.

2.05 SURFACE METAL RACEWAY

- A. Formed steel or aluminum type. Standard factory finish. Where color choice is available, consult Engineer for selection prior to ordering.

2.06 RIGID NON-METALLIC CONDUIT (PVC)

- A. Schedule 40 rigid polyvinyl chloride type unless otherwise noted.

2.07 RIGID ALUMINUM CONDUIT

- A. Permitted only in specified locations.
- B. Fittings copper free cast aluminum.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install Raceway concealed in construction unless noted otherwise on the Drawings or specifically approved in writing by the Engineer.
- B. Cut Raceway ends square, ream and extend maximum distance into all couplings and connectors.
- C. Provide and install manufactured end caps on all Raceway ends during construction to prevent the entrance of water or dirt. Tape, as a cover, not permitted.
- D. Swab out all Raceways before pulling wires.
- E. All elbows for GRS and PVC Raceway shall be factory radius bends. For all other Raceway, use factory radius bends of 1-1/4" and larger diameter.
- F. Raceway shall not penetrate sheet metal ducts unless permission is granted by Engineer. All sleeves shall be provided for Raceway installation.
- G. Provide 2 - 3/4" C.O. stub into accessible ceiling space from all recessed panelboards or systems terminal boxes.

3.02 GALVANIZED RIGID STEEL CONDUIT

- A. All Connections shall be watertight. Install for all Raceways in concrete or where subject to damage.

3.03 INTERMEDIATE METAL CONDUIT

- A. Intermediate metal conduit is permitted as a substitute for galvanized rigid steel conduit except where GRS is required by code.

3.04 ELECTRICAL METALLIC TUBING

- A. Install for wiring in masonry, frame construction, furred ceilings and above suspended ceilings. May be used for exposed work in unfinished areas where not subject to damage. Where construction involves masonry work, surface cut masonry units wherever such masonry units are to remain unplastered or uncovered in complete construction.

3.05 RIGID ALUMINUM CONDUIT

- A. May be used in lieu of galvanized rigid steel conduit where Raceway is run above grade or inside of buildings; rigid aluminum conduit not permitted where Raceways are encased in or attached to concrete or are below grade.

3.06 RACEWAYS UNDERGROUND

- A. Galvanized rigid steel conduit - painted with two coats of bitumastic paint - or galvanized rigid steel conduit with 15 mil. polyvinyl chloride (PVC) jacket (repair abrasions with PVC base paint or PVC)
- B. PVC Raceways may be used for underground runs when permitted by code. Field bends, when necessary, shall be formed only with factory recommended heater. Penetrations through floor and walls shall be galvanized rigid steel conduit. PVC, if used, shall be increased in size

from that shown to include code required ground wire. Bends in excess of 10 degrees shall be GRS.

- C. Arrange and slope Raceways entering building to drain away from building.
- D. Ground wires shall be provided in all PVC Raceway.

3.07 INSERTS, SHIELDS AND SLEEVES

- A. Furnish and set in place, in advance of pouring slabs and walls, all inserts and sleeves needed to execute Division 26 equipment installation.
- B. Where supports in slabs are required after wall has been poured, use a drilled-in threaded insert, installed as recommended by Manufacturer.
- C. Sleeves shall be provided for all wall penetrations.

3.08 RACEWAYS THAT STUB UP THROUGH FLOOR

- A. Install at such depth that the exposed Raceway is vertical and no curved section of the elbow is visible.
- B. PVC Raceway shall not be stubbed through floors.

3.09 SEALING OF RACEWAY PENETRATIONS

- A. Exterior Wall Surfaces Above Grade: Seal around all penetrations with caulking approved by Engineer. For concrete construction above ground level, cast Raceway in wall or core drill wall and hard pack with a mixture of equal parts of sand and cement.
- B. Exterior Surfaces Below Grade: Cast Raceway into wall (or floor) or use manufactured seal assembly (such as O.Z. type "FSK") cast in place.
- C. Roofs: Provide mopped, lead, roof jack where Raceway penetrates roof membrane.
- D. Fire Rated Floors, Walls, Ceiling/Roofs: Concrete or masonry, seal around Raceway penetration with Dow Corning 3-6548 silicone RTV foam or approved equal. Plaster or gypsum wallboard, seal around Raceway penetration with plaster, fire tape per local Fire Marshal's requirements.

3.10 SEALING OF RACEWAYS

- A. Seal interior of all Raceways which pass through buildings roofs, floors or through outside walls of the building, above or below grade. Seal on the end inside the building using duct sealing mastic, non-hardening compound type, specially designed for such service to maintain the integrity of the seal of the wall, floor or roof. Pack around the wires in the Raceways.

3.11 HANGARS FOR RACEWAYS

- A. In suspended ceiling spaces Contractor may, at his option, attach 1/2" or 3/4" EMT Raceways to the ceiling suspension system where such system is structurally suitable on independent wire secured at both ends; in which case, provide clips manufactured for the purpose.
- B. When more than two Raceways will use the same routing, group together on a patented channel support system (such as Unistrut).

3.12 SURFACE METAL RACEWAY

- A. Install parallel to building surface (i.e., wall, ceiling, floor). Fasten to surface as recommended by Manufacturer. Mount so Raceway is in the least obvious location. Shall be used in lieu of conduit in finished areas.

3.13 FLEXIBLE CONDUIT

- A. Flexible conduit shall be used only for connection to motors and equipment subject to vibration with 90 degrees loop minimum to allow for isolation and for lay-in LED fixtures above T-Bar ceilings. For fixture installations, one end of flex must terminate in rough-in junction box. Flex conduit shall not be installed over 6' long or used to connect from fixture to fixture. Use liquid tight for pumps, equipment which is regularly washed down, and equipment in damp locations. Provide ground wire.

3.14 PULL CORDS

- A. Nylon type shall be included in all installed empty Raceway.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 INTRODUCTION

- A. The work covered in this section is subject to all of the requirements in the general conditions of the specifications. Contractor shall coordinate all of the work in this section with all the trades covered in the other sections of the specification to provide a complete and operative system.

1.03 DESCRIPTION OF WORK

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is defined to include low voltage lighting control panels, switch inputs, and wiring.
- B. The work covered by this section of the specifications shall be coordinated with the related work as specified elsewhere under the project specifications.

1.04 QUALITY ASSURANCE

- A. UL & ULc Approvals: The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards by a nationally recognized testing laboratory.
- B. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.
- C. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA standards regarding the types of electrical equipment enclosures.
- D. Component Pre-Testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.
- E. System Checkout: A factory-trained technician or factory-authorized personnel or Contractor shall functionally test the control system and verify performance after installation.
- F. Manufacturer: These specifications are based on the Digital Lighting Management System as manufactured by WattStopper. Substitutions of the specified equipment will be considered providing sufficient documentation is provided to the Engineer which certifies that the equipment qualification meets the requirements of this specification.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's data on lighting control system and components.
- B. Shop Drawings: Submit drawings of lighting control system and accessories including, but not necessarily limited to, the low voltage relay panels, power wiring, and switch inputs.
 - 1. Riser Diagram/System Diagram
 - 2. Switch Input Wiring
 - 3. Show exact location of all digital devices, including at minimum sensors, room controllers and switches for each area indicated.
 - 4. Provide sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

1.06 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
 3. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.
 4. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
 5. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.
 6. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 7. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control
 8. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
 9. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
 10. Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.

1.07 LIGHTING CONTROL APPLICATIONS

- A. Minimum lighting control performance required, unless local Energy Code is more stringent.
1. Occupancy/vacancy requirements – Provide an occupancy/vacancy sensors with Manual On/ Automatic Off or Automatic On/ Automatic Off functionality in all spaces. Manual On vacancy sensors should be used for any enclosed space with a Manual On switch that does not require hands free operation. Spaces with multiple occupants or where line of sight might be obscured ceiling or corner mount sensors and Manual wallstations would be required. Automatic On of lighting via occupancy sensor cannot exceed 30% of lighting. Systems that do that allow the user to select Occupancy or Vacancy mode shall not be acceptable.

2. Daylight Zones – Primary sidelit or toplit areas within an enclosed space shall be controlled separately and automatically by a multi-level photocontrol device without the need for programming. Adjustments to the daylight zones must be provided by a simple to use, intuitive remote handheld device.
3. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to dim electric light to the lowest light level.
4. Provide the ability to adjust the high end and low end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
5. Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10V dimmers and relays are tied together reduce design capabilities and shall not be acceptable.

1.08 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Ceiling mounted sensors
- B. Digital wall stations
- C. Room Controllers (Daylight Harvesting Controllers)
- D. Daylight Photosensors

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. Wall or Ceiling Mounted Occupancy Performance Requirements:
 1. Sensing mechanism:
 - a. Dual technology:
 - 1) Utilize multiple segmented lenses, with internal grooves to eliminate dust and residue build-up.
 - 2) Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
 - 3) Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.
- B. Power Failure Memory:
 1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
- C. Designed and tested to withstand discharges of 15,000 volts per IEC 801-2 without impairment of performance.
- D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.
- E. Sensor shall have time delays from 10 to 30 min.
- F. When specified, sensors shall automatically adjust time delay and sensitivity settings.
- G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

- H. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- I. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

2.02 CEILING MOUNTED SENSORS

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 - 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 - 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - 1) Ultrasonic and Passive Infrared
 - 2) Ultrasonic or Passive Infrared
 - 3) Ultrasonic only
 - 4) Passive Infrared only
 - 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 - 4. One or two RJ-45 port(s) for connection to DLM local network.
 - 5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Manual override of controlled loads.
 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. Units shall not have any dip switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.03 DIGITAL WALLSTATIONS

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Configuration LED on each switch that blinks to indicate data transmission.
 4. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
 6. Programmable control functionality including:
 - a. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
 7. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. Two RJ-45 ports for connection to DLM local network.
1. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- C. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- D. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.04 ROOM CONTROLLERS

- A. Room Controllers are fully functional out-of-the-box to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will include line voltage wiring space and will not require additional electrical junction boxes. The control units will include the following features:
- B. Fully functional room configuration to the most energy-efficient sequence of operation based upon the connected devices in the room.
- C. Simple replacement – Using the automatic configuration capabilities, a Room Controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
- D. Quick installation features including:
1. Included line voltage space to simplify wiring and eliminate the need for separate junction boxes.
 2. Included emergency voltage space to simplify wiring of emergency luminaire connections.
 3. Breakouts for direct conduit connection.
 4. Line and low voltage sections include conduit connection points. Systems that require special accessories for direct conduit connections may not comply with local building codes and shall not be acceptable.
 5. Quick low voltage connections using standard RJ-45 QuickConnect cable.
 6. Dual voltage (120/277 VAC, 60 Hz).
 7. Zero cross circuitry for each load.
 8. Three relay configuration.
 9. Efficient 150 mA switching power supply.
 10. Six RJ-45 Click & Go local network ports.
 11. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.
- E. On/Off/Dimming Room Controllers shall include:

1. Real time current metering (optional).
2. Three relay, two 0-10V dimming zone configuration RC3D2.
3. Three relay, three 0-10V dimming zone configuration RC3D.
4. Three relay, three 0-10V dimming zone configuration for patient rooms RC3DEHC.
 - a. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.
 - b. Up to three 0-10V analog outputs per relay for control of compatible ballasts and LED drivers.

F. WattStopper catalog numbers: LMRC-211, LMRC-212.

2.05 DAYLIGHT PHOTOSENSORS

- A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
 1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
 2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
 3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.
- B. Digital daylighting sensors shall include the following features:
 1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 2. Sensor light level range shall be from 1-6,553 footcandles (fc).
 3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
 4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
 5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
 6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
 7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.

8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
 9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
 10. Configuration LED status light on device that blinks to indicate data transmission.
 11. Status LED indicates test mode, override mode and load binding.
 12. Recessed switch on device to turn controlled load(s) ON and OFF.
 13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode – on/off, bi-level, tri-level or dimming
 14. One RJ-45 port for connection to DLM local network.
 15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
 16. Any load or group of loads in the room can be assigned to a daylighting zone
 17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
 18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
 2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
 3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
 4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this con
 2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
 3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
 4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
 5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
 6. Device must include extendable mounting arm to properly position sensor within a skylight well.
 7. WattStopper product number LMLS-600

2.06 ROOM CONTROLLER LOCAL NETWORK

- A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.

3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Remain off
 - c. Turn on to last level
7. Each load shall be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
 - a. Load status
 - b. Electrical current
 - c. Total watts per controller
 - d. Schedule state – normal or after-hours
 - e. Demand response control and cap level
 - f. Room occupancy status
 - g. Total room lighting and plug loads watts
 - h. Total room watts/sq ft
 - i. Force on/off all loads
10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads

(forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.

13. Zero cross circuitry for each load
 14. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay:
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.
 - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
9. Override button for each load provides the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

2.07 DLM LOCAL NETWORK (ROOM NETWORK)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
 1. Plug n' Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 3. Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
- D. If manufacturer's pre-terminated Cat 5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION AND DOCUMENTATION

- A. Installation: The control system shall be installed and fully wired as shown on the plans by the installing Contractor. The Contractor shall complete all electrical connections to all control circuits and override wiring.
- B. Documentation: The Contractor shall provide accurate "as-built" drawings to the Port for correct programming and proper maintenance of the control system. The "as-builts" shall indicate the load controlled by each relay and the relay panel number.
- C. Operation and Service Manuals: The factory shall supply all operation and service manuals as related to the design of the control system.
- D. All low voltage smart devices shall connect using QuickConnect wire provided by Cooper Controls. When using wire for connections other than the QuickConnect low voltage wire (pre-defined lengths of RJ45 cable), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contractor termination requirements.
- E. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- F. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.).
 - 3. Load parameters (e.g. blink warning, etc.).

3.02 PRODUCT SUPPORT AND SERVICE

- A. Factory Support: Factory telephone support shall be available at no cost to the Port. Factory assistance shall consist of solving programming or application questions concerning the control equipment. The factory shall maintain toll-free numbers for technical support for their customers.

3.03 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The contractor shall provide both the manufacturer and the engineer with twenty one working days written notice of the system startup and adjustment date.
- C. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the Engineer on the adjustment and maintenance of the system.

3.04 SYSTEM ACCEPTANCE

- A. The Contractor is responsible for complete installation of the system according to strict factory standards and requirements. The following items shall be included requirements:
 - 1. All system equipment shall operate in accordance with specification and industrial standard procedures.

2. An operational user program shall exist in the control system. The program shall execute and perform all functions required to effectively operate the site according to the requirements.
3. Demonstration of program integrity during normal operation and pursuant to a power outage.
4. Contractor shall provide a minimum of three hours training on the operation and use of the control system. Additional support services shall be negotiated between the Contractor and the building Owner or manager.

3.05 WARRANTY

- A. Warranty: Manufacturer shall supply a two-year warranty on all hardware and software. A limited 10-year warranty shall be provided on the standard relay card.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SCOPE

- A. Furnish and install dry type isolation transformers of the types, sizes and quantities indicated on the contract drawings. Provide all lugs, accessories and mounting hardware necessary for proper installation and operation.

1.03 SUBMITTALS

- A. Provide product information prior to fabrication and installation. Product data shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.
- B. When requested, provide additional product data and certifications necessary to show conformance with this specification.
- C. Provide information for record purposes including field test reports and maintenance data as required.

1.04 RELATED STANDARDS

- A. Provide transformers in accordance with the following standards, where applicable:
 - 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 - 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 - 3. NEMA ST 20, Dry Type Transformers for General Applications
 - 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
 - 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
 - 6. NFPA 70, National Electrical Code
 - 7. IEEE C2, National Electrical Safety Code

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle transformers in accordance manufacturer's recommendations. Utilize factory provisions for all lifting, rigging, or hoisting.
- B. Store transformers prior to installation in a temperature and humidity controlled space. If such a space is not available, apply temporary heat in accordance with the manufacturer's instructions within each ventilated type transformer case to exclude moisture and condensation.

1.06 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Dry Type Transformers
- B. Vibration Isolators

PART 2 - PRODUCTS

2.01 MANUFACTURER(S)

- A. The low voltage dry type transformer(s) shall be Type RSP as supplied by Siemens Energy and Automation.

- B. Transformers specified in this Section and power distribution equipment feeding and being fed by the transformers shall be warranted and serviced by the same manufacturer. Manufacturer shall have a local field service organization available on an as needed basis.

2.02 GENERAL

- A. Transformers shall be of the reduced size, self cooled and fan cooled, two winding, dry type designed for 60 Hz operation. Transformers shall be designed, manufactured and tested in accordance with the latest ANSI, NEMA and IEEE Standards and shall be listed and labeled in accordance with UL 1561.
1. Transformers shall be approximately 30% smaller than standard offering.
 2. Transformers shall have disconnect switch with shunt trip on primary.
 3. Transformers shall have cooling fans to assist in dissipating heat during heavy loading.
 4. Transformers shall have thermal switches at 125 degC to engage cooling fan, 225 degC to sound audible alarm, 230 degC to activate shunt trip of disconnect on primary.
 5. Transformers shall operate 2 db below NEMA standard sound levels.
 6. Transformers shall have dry contacts for remote monitoring connections.
 7. Transformers shall have TP-1 Energy Efficient ratings.
 8. Transformer impedance shall be a minimum of 3 and a maximum of 5%.
 9. The transformer shall be UL listed and rated for non-sinusoidal loads with a K factor of 13.
- B. Insulation System:
1. Transformers 15 KVA and larger shall be of the ventilated type and have a UL recognized 220°C insulation system. The KVA ratings shall be based on an allowable 150°C winding temperature rise above a 30°C hot spot.
 2. Transformer design KVA rating shall be suitable for a 30°C average, 40°C maximum ambient temperatures.
- C. Core and Coil:
1. Core construction shall be of non-aging electrical grade grain-oriented silicon steel to minimize hysteresis and eddy current losses. Core laminations shall be tightly assembled.
 2. Neutral bus shall be sized for 200% of secondary full load current.
 3. Windings shall be wound of high quality copper.
 4. Ventilated windings shall be arranged to brace coil layers and provide maximum ventilation. Core and coil assemblies shall be constructed to provide short circuit withstand capability as defined by ANSI and NEMA standards. The complete assembly shall be installed on vibration dampening pads to reduce noise and securely bolted to the enclosure base. A flexible grounding conductor shall be installed between the core and coil assembly and the transformer enclosure.
 5. Core and coil sealing process:
 - a. The complete core and coil assembly shall be impregnated with non-hydroscopic thermo-setting polyester varnish to provide a high dielectric and flame retardant seal.

- b. The shield of varnish to the coils shall effectively impregnate the entire core and coil assembly that results in a unit which is virtually impermeable to moisture, dust, dirt, salt air and other industrial contaminants.
 - c. Encapsulated core and windings shall be cast in a resin compound to provide a moisture-proof, shock-resistant, high dielectric seal.
- 6. Core lamination clamping angle shall be of adequate thickness and hardness to insure a tight and rigid core assembly to eliminate movement of core plates. Welded core designs shall include multiple beads as necessary to insure a tight and rigid core assembly to eliminate core plate movement.
- 7. Provide full capacity taps in the high-voltage windings as follows:
 - a. 15 KVA through 500 KVA step-down transformers: 2 – 2½ % full capacity above normal and 4 – 2½ % full capacity below normal.
- D. Enclosures:
 - 1. Ventilated enclosures shall be of heavy gauge steel construction of NEMA 3R construction for outdoor use with the addition of weather shields and NEMA 1 for indoor installation. Front and rear covers shall be removable to provide access to terminal compartment(s). Terminals shall be fully sized to carry the transformer full load current and shall be arranged to accept UL listed cable connectors.
 - 2. Encapsulated transformers shall have non-ventilated enclosures rated for indoor or outdoor use in accordance with UL specifications. Wiring compartments shall have flexible cable leads suitable for connecting field wiring and marked for easy identification. Encapsulated design enclosures shall include knockouts into wiring compartment and wall mounting brackets.
 - 3. Enclosure wiring space and positioning of terminals shall allow for adequate cable bending space.
 - 4. Finish enclosures in ANSI 61 gray paint.
 - 5. Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections and catalog number, as applicable.
- E. Sound:
 - 1. Unless otherwise specified, sound levels shall be in accordance with values allowed by NEMA ST-20.
- F. Accessories:
 - 1. Provide weather shields for ventilated transformers installed outdoors conforming to the requirements of NEMA 250, Type 3R

2.03 VIBRATION ISOLATORS

- A. Spring vibration isolators shall be B-Line model HMT or equal with neoprene top and base.
- B. Vibration pads shall be cork, neoprene, and steel construction, B-Line model CNNK or equal.
- C. Neoprene pad spacers shall be B-Line model NNP or equal.

PART 3 - EXECUTION

3.01 MOUNTING

- A. Transformers shall be attached to the building structure to prevent overturning in the event of earthquake. All attachment nuts to have washer and rubber pad spacer under them. Provide neoprene pad spacers under mounting rails. Transformers shall be mounted on floor, wall or suspended from ceiling as noted in the contract documents or as required. Remove all shipping blocks prior to installation.
- B. Transformers with enclosures designed for floor mounting where suspended from ceiling shall be suspended on a trapeze constructed of a minimum of two horizontal structural channels hung from threaded rods attached to structural members or inserts in structural slab. Channel, rod, and inserts shall be sized for not less than 400% load safety factor.
- C. Transformers shall be installed with four spring vibration isolators, one at each corner, when any of the following conditions are present. Size each isolator for the full transformer weight.
 - 1. Transformer is 45 KVA or larger.
 - 2. Transformer is located higher than one floor above grade.
 - 3. Transformer is noted "SIM" in the contract documents.
- D. All transformers mounted directly on a wall shall be mounted with vibration pads sized to give 400% safety factor.

3.02 CONNECTIONS

- A. 208/120 volt three phase secondary transformers shall be considered "grounded neutral separately derived systems" and be grounded per code accordingly.
- B. Transformer raceway connections shall be flexible metal raceway. See Specification Section 26 05 33.
- C. Voltage Tap Connection: Connect all transformers at "normal" tap. After facility is completely energized, measure secondary voltages at all transformers and service switchboard. Forward a list to the Engineer for evaluation. Include copy in O&M Manuals. Reconnect taps as subsequently directed.

3.03 TEST

- A. Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.
 - 1. Inspect accessible components for cleanliness, mechanical and electrical integrity and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
 - 2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.

3.04 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.05 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.

- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide all panelboard equipment, complete; dead front type.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Panelboard
- B. Circuit Breakers
- C. Panel Schedules

PART 2 - PRODUCTS

2.01 PANELBOARD TYPE

- A. Panelboards shall be rated at proper voltage and current for intended use with busbars of copper or aluminum. Panels shall be 3-phase, 4-wire, 100% neutral, unless noted otherwise. Where aluminum is utilized, all lugs shall be of an approved compression type. Provide multiple lugs where conductors in parallel or "feed through" are shown on the Drawings.
- B. Conductor Connectors shall be bolted to busbars using Grade 5 bolts and Belleville washers. Feeder conductor connectors shall be rated for 75 Degree C. wire when 75 Degree C. wire is indicated. Where aluminum conductors are utilized for feeders or branch circuits the connectors shall conform with Section 26 05 19.
- C. Panelboards shall have a separate ground bus bonded to the panelboard frame.
- D. Where 120-Volt, 15- or 20-Amp breakers are intended for switching loads they shall be of type rated for switching duty labeled "SWD."

2.02 ACCEPTABLE MANUFACTURERS

- A. General Electric
- B. Square-D
- C. Siemens
- D. Cutler-Hammer

2.03 CIRCUIT BREAKERS

- A. The following interrupting capacity, 10,000 AIC Symmetrical shall be considered minimum. Other ratings shall be as specified on panel schedules shown on the Drawings. Series rating of breakers is not allowed.
- B. Mount breakers in all panelboards so that breaker handles operate in a horizontal plane. Bolt in type only. Provide common trip on all multiple pole breakers.
- C. Where noted, provide spare breakers, complete for future connection of wiring circuits. Where "Space" is indicated for breakers, provide all bussing and breaker mounting hardware in the panelboard, provide steel knockouts in dead front metal closure of unused part of panel. If any steel knockouts are removed, provide breakers in such spaces or approved coverplates. Open spaces are not permitted.

- D. For multi-wire branch circuits, provide approved breaker handle ties where required by NEC 210.4.
- E. An Arc-fault circuit interrupter shall be provided for all receptacles, lighting fixtures, and smoke detector in bedrooms/living units.

2.04 CABINET FOR EACH PANELBOARD

- A. Flush or surface, as indicated; tight closing doors without play, when latched. Where two cabinets are located adjacent to each other in finished areas, provide matching trim of the same height. Where a remote controlled switch or contactor is mounted in any panelboard, mount on same frame as panelboard interior with screw retained access door in dead front shield; common door over circuit breakers and remote controlled device. Where flush mounted, provide (2) 3/4" conduits to accessible ceiling space for future expansion.
- B. All conduits for future expansion shall stub into a junction box, where located above grade, and shall be sealed in the panel.
- C. Provide cabinets of sufficient dimensions to allow for future expansion and addition of circuit breakers within the panelboards as indicated on panel schedules.
- D. Provide cabinet front with full-height hinged door. One door over the interior and an additional hinged dead front cover over interior and wireway (door-in-door). Full-height front cover hinged to box with concealed trim clamps. Provide flush door locks.
- E. Provide lock for each cabinet door. All Electrical Distribution Equipment Locks shall be keyed identically. Key system shall match existing. Supply the Port with minimum six keys.
- F. Fasten panelboard front with machine screws with oval counter-sunk heads, finish hardware quality, with escutcheons or approved trim clamps. Clamps accessible only when dead front door is open are acceptable. Surface mounted panelboards with fronts greater than 48 inches vertical dimension shall be hinged at right side in addition to hinged door over dead front.
- G. Finish: Provide factory prime coat for cabinets to be located in finished areas. Where cabinets are located in unfinished areas, standard lacquer or enamel finish, gray or blue-gray color, shall be substituted for factory prime coat.

2.05 SYSTEM OF NUMBERING AND BUS ARRANGEMENT

- A. Shall be as shown on the Panel Schedules on the Drawings.

2.06 PANELBOARD NAMEPLATE

- A. Provide engraved and filled (or color layer - engraved through outer layer) plastic nameplate with 1/2-inch high characters (for panel name); attached with screws to each NEMA 1 panelboard front. White on black, include voltage, phases, wires and minimum A.I.C. Rating in 3/8-inch characters.
- B. Nameplate color shall be:
 - 1. Normal System: White letters on black
- C. Provide a service entrance label nameplate on the main panelboard which includes the following:
 - 1. Architect
 - 2. Electrical Consultant
 - 3. Electrical Contractor

4. Date of Installation
 5. Service Voltage & Bus Amperage Rating
 6. Symmetrical Short Circuit Current Rating
 7. Year of Manufacture
- D. Provide a riser diagram drawing using non-fading ink and mylar installed under glass and attached to the exterior of the main panelboard showing feeder runs, panels, transformers and raceway sizes.

PART 3 - EXECUTION

3.01 MOUNTING

- A. Secure in place with top of cabinet at 6'-0", unless otherwise noted. Top of cabinet and trim shall be level. Firmly anchor cabinets directly or with concealed bracing to Building Structure. When panels are not located in or directly on a wall, provide a support frame of formed steel channel which is anchored to the floor and Ceiling Structure. Interiors shall not be installed until Structure is totally enclosed. Where panels are mounted adjacent to each other, the top edges shall be at the same height.

3.02 CIRCUIT INDEX

- A. For each branch circuit panelboard provide a typewritten index listing each circuit in the panelboard by number with its proper load designation. Mount with a transparent protective cover inside cabinet door. Listing shall match circuit breaker arrangements, typically with odd numbers on the left and even numbers on the right. Room numbers used shall be final room numbers used in the building as verified with the Port, and not room number assigned on Plans.

3.03 CABINET PAINTING

- A. Cabinets furnished as prime painting shall be field painted to match color of adjacent wall.

3.04 SPACE

- A. Verify space available with equipment sizes and Code Required Working Clearances prior to Submittal of Shop Drawings.

3.05 GROUNDING

- A. Provide separate ground busbar for all panels supplying isolated ground circuits.

3.06 FEED THROUGH AND DOUBLE LUGS

- A. Provide feed through or double lugs with amperage equal to the incoming feeder amperage unless shown as larger.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Work under this section includes all requirements for motor controls to be furnished under the electrical portion of the work on all electrical motor driven equipment. Individually mounted starters shall be provided by the new Contractor. Motor controls shall conform to NEMA Standards for each specific purpose.
- B. The new Contractor shall furnish all motor controllers not included with equipment furnished under other divisions of these specifications or by Engineer. The new Contractor shall install all motor controllers including all controllers not factory assembled into equipment furnished under other divisions of these specifications or by Engineer.

1.03 MOTOR VOLTAGE INFORMATION

- A. Voltages available are 480 Volt, 3 phase or 208 Volt, 3 Phase, and 115 Volt Single Phase.
- B. Circuits are designed (in general) for motors as follows:
- C. Smaller than 1/2 H.P. - 115 Volts, Single Phase 1/2 H.P. and larger - 460 or 200 Volts, 3 Phase
- D. Verify motor sizes and voltages provided under other divisions and notify General Contractor immediately if any discrepancies are noted.

1.04 REGULATORY REQUIREMENTS

- A. Provide motor protection switches of the appropriate NEMA size. For units not using NEMA rating, use equivalent NEMA size.

1.05 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Motor Starters
- B. Fan Shutdown Relays

PART 2 - PRODUCTS

2.01 MOTOR STARTERS

- A. Magnetic Motor Starters: Unless noted otherwise, shall be full voltage non-reversing with three overloads sized to suit nameplate amperes of motor served, motor "On" and "Off" pilot lights, "Hands-Off-Auto" switch, and auxiliary contacts for interlocking.
- B. Combination Motor Starter/Disconnect: Shall be fused switch type with all features of Paragraph A above. In addition, provide disconnect switch auxiliary contacts for disconnection of externally powered control circuits where applicable. Fuses shall be sized in accordance with motor manufacturer's requirements.
- C. Manual Starters: Shall be toggle switch or push-button type, lockable in the "Off" position, with overload relays, pilot light and enclosure pursuant to Paragraph D below. Manual starters shall only be used where specifically shown or called out on the drawings and only for single phase, fractional horsepower motors.
- D. Enclosures: All motor controllers shall be contained in an enclosure suitable for the environment in which the controller is mounted, and shall be weatherproof when exposed to weather.

- E. Overload Devices: Shall be melting alloy or bimetallic type. One overload shall be provided for each phase. Provisions shall be made for resetting the overload devices from outside the starter enclosure. Provide ambient compensated overload devices only when the motor is at a constant temperature and the controller is subject to a separate, varying temperature. Automatic reset overload devices are not permitted.

2.02 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. Allen Bradley
- C. General Electric
- D. Cutler-Hammer
- E. Siemens

2.03 NAMEPLATES

- A. Pursuant to Section 26 00 00, Paragraph 2.5, provide nameplates permanently attach (with screws on NEMA 1 enclosures) on each controller, nameplates with the following information: Load served, voltage, phase, short circuit rating, panel/circuit number and where applicable fuse size and type.

2.04 FAN SHUTDOWN RELAYS

- A. Contractor shall provide relay(s) with sufficient contacts to shutdown all fans over 2000 cfm upon receipt of Fire Alarm. See Section 28 31 00. Coordinate coil voltage with Fire Alarm System Supplier.

2.05 POWER FACTOR CORRECTION

- A. Provide power factor correction capacitors for all motors 25 horsepower and above. Capacitor size when indicated on the drawings is an approximation only. Final size shall be determined by the Contractor based on the recommendations of the motor manufacturer to bring the power factor to between 0.9 and 0.95. All capacitors are to be fused, with blown fuse indicators mounted on the front of the unit. Provide discharge resistors when required by code.

PART 3 - EXECUTION

3.01 FINISHED AREAS

- A. In finished areas, mount motor protection switches flush and install suitable coverplates.

3.02 HEATERS

- A. Install heaters co-related with full-load current of motors provided.

3.03 OVERLOADS

- A. Set overload devices to suit motors provided.

3.04 SUPPORTS

- A. Securely mount to equipment, wall or acceptable mounting frame.

3.05 FAN SHUTDOWN WIRING

- A. Provide wiring interlock connections for all (over 2000 cfm) fan starter control circuits via Division 23 furnished fan shutdown relay to shutdown fans upon receipt of Fire Alarm.

3.06 FAN SHUTDOWN WIRING

- A. Provide wiring interlock connections for all (over 2000 cfm) fan starter control circuits via to shutdown fans upon receipt of Fire Alarm.

3.07 CONNECTION TO MECHANICAL EQUIPMENT ON ROOFS

- A. The Contractor shall coordinate all roofing penetrations with the general contractor and roofing contractor to assure that the roofing warranty is maintained.
- B. Attachment of conduits to the roof to serve mechanical equipment and devices shall comply with Section 260533.

3.08 MECHANICAL EQUIPMENT NAMEPLATE RATINGS

- A. The Contractor shall verify that the nameplate ratings of the mechanical equipment, when they arrive on site, are consistent with the ampacity called out on the drawings. The Contractor shall bring any discrepancies to the Engineers attention prior to installation of conduit and wiring.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide all wiring devices and plates.
- B. No push-in terminals allowed.
- C. All devices color shall be ivory, unless otherwise noted.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Switches
- B. Receptacles
- C. Device Plates
- D. Occupancy Sensors

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Hubbell
- B. Pass & Seymour
- C. Leviton
- D. Cooper

2.02 SWITCHES

- A. "Industrial Specification Grade", quiet type, rated 277 volt, 20 amp, unless noted, with plastic handle. Single pole, double pole, 3-way, or locking type as required. Meets Fed. Spec. WS-896 Provide matching styles and colors in other devices as required for the conditions of installation. Hubbell CS1221, Cooper CSB120, Leviton 1221, and P&S 20AC1
- B. Interchangeable type shall be rated same as above.
- C. Momentary Contact Line Voltage Switches: Single pole, double throw, 3-wire, normally open. Rating same as above.
- D. Key Operated: Hubbell HBL1221L (or equal) with 1209 Key. Provide 24 spare Keys.
- E. Motor rated switches: Switches serving as motor disconnecting means shall be horsepower rated with overload relays and meet requirements as stated above. See manual starters in Section 262419, 'Motor Controllers'.
- F. Device plates shall be Hubbell and Cooper Type 302 stainless steel.

2.03 RECEPTACLES

- A. "Industrial Specification Grade", Duplex NEMA 5-20R configuration (20-Amp, 120-Volt) unless shown otherwise. Must have "rivetless ground" contact manufactured as an integral component of the external ground screw terminal. Meets Fed Spec. WC-596 Hubbell HBL5362, Cooper 5362, P&S 5362A, and Leviton 5362.

- B. Ground-Fault Circuit-Interrupter Duplex Receptacles: NEMA 5-20R. Hubbell GF20ILA, and Cooper VGF20, for 20 Amp, 125-Volt AC. Provide GFI receptacles where required by code.
- C. Duplex NEMA 5-20R configuration, isolated ground, orange color. Leviton 5362 IG, and Cooper IG5362.
- D. Weather Resistant (WR) / Ground Fault Circuit-Interrupter (GFCI) Outdoor Duplex Receptacles: NEMA 5-20R. Hubbell GFTR201 or equal, for 20 Amp, 125-Volt AC.
- E. Special Purpose Receptacles: For special purpose receptacles, see drawings for voltage, amperage, and phase. Provide with matching plug delivered to the Port.

2.04 DEVICE PLATES

- A. Interior: Plates for receptacles other than NEMA 5-20R shall have ampere rating, voltage and phase engraved in the plate. Plates for recessed boxes shall be Hubbell and Cooper Type 302 stainless steel. Attachment screws shall match finish of plate. Plates for surface mounted boxes shall be of pressed stainless steel with size to fit exactly the box used.
- B. Exterior: Intermatic # WP1010MC, for vertical mount and # WP1010HMC for horizontal mount, or equivalent for receptacles. Metal cover shall be raintight while-in-use.

2.05 MULTIOUTLET ASSEMBLY (WHEN SHOWN)

- A. Provide assemblies complete, including necessary fittings and hardware with circuits as indicated on Plans and outlet spacing as indicated. All assemblies shall contain ground wire. Wiremold or equal.

2.06 SPARE DEVICES

- A. Provide the following spare devices:

<u>Device</u>	<u>Quantity</u>
Single-pole switch	3
Duplex receptacle	5
Dedicated duplex receptacle	3
GFI receptacle	3
20A, single-phase equipment connection	5
20A, three-phase equipment connection	3

- B. Each spare device shall include 100 feet of conduit, wire, faceplate and labor; all as required for a complete installation. Location of these units to be determined by the Engineer. Unused devices shall be turned over to the Port.

2.07 OCCUPANCY SENSORS

- A. Provide self-adjusting occupancy sensor light switching devices for control of lighting in all rooms and offices shown on drawings.
- B. Ceiling mounted dual-technology Occupancy sensor shall be Wattstopper model DT-300 or equal; complete with power pack and associated mounting hardware.
- C. Ceiling mounted dual-technology Vacancy sensor shall be Wattstopper model DT-300 or equal; complete with power pack and associated mounting hardware. Provide compatible, normally open, momentary switch, Wattstopper model RH-253 for vacancy sensor wall switch.

- D. Combination switch/dual-technology occupancy shall be Wattstopper model DW-100. Set relay to "Occupancy Sensor On Mode" for vacancy sensor switch function as indicated on the drawings.
- E. Combination switch/dual-technology vacancy sensor shall be Wattstopper model DW100. Set relay to "Manual On Mode" for vacancy sensor switch function as indicated on the drawings.
- F. Sensors shall be ceiling or wall mounted to provide adequate coverage.

PART 3 - EXECUTION

3.01 MOUNTING

- A. Rigidly fasten each device to the outlet box at proper position with the wall to bring receptacle flush with plate or switch handle the proper distance through the plate.

3.02 ORIENTATION

- A. Set Switches vertical with handle operating vertically, up position "ON".
- B. Set Receptacles vertical with ground slot down.

3.03 DEVICE PLATES

- A. Shall be stainless steel for each new wiring device and for each telephone and signal equipment outlet, except where equipment mounted thereon covers the outlet box completely.
- B. Provide new covers on existing outlet boxes being reused.

3.04 RECEPTACLE GROUNDING

- A. Provide bare bonding wire between receptacle grounding terminal and box. Plaster ear screws connecting frame to the box will not be acceptable for grounding.
- B. Provide green insulated grounding conductor in all branch circuits supplying isolated ground and ground-fault circuit-interrupter type receptacles.

3.05 HANDICAPPED ACCESS

- A. Comply with requirements of Washington State Handicapped Access Code.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide all fuses as required. Provide three (3) spare of each size and type required. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the jobsite or from water that may contact the fuse before the equipment is installed. Final tests and inspections shall be made prior to energization of the equipment. This shall include a thorough cleaning, tightening, and review of all electrical connections and inspection of all grounding conductors. All fuses shall be furnished by the Electrical Contractor. All fuses shall be of the same manufacturer.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Fuses for Branch Circuits

PART 2 - PRODUCTS

2.01 MAINS, FEEDERS, AND BRANCH CIRCUITS

- A. Circuits 601 to 6000 amperes shall be protected by current limiting BUSSMANN Low-Peak Time-Delay Fuses KRP-C. Fuse links shall be pure silver links (99.9% pure), delay and must hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in .01 seconds or less and be listed by Underwriters Laboratories Inc., with an interrupting rating of 200,000 amperes r.m.s.
- B. Circuits 0 to 600 amperes shall be protected by current limiting BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284°F. melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse must hold 500% of rated current for a minimum of 10 seconds and be listed by Underwriters Laboratories, Inc., with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class RK1 to maintain the Engineered protection of the system components.
- C. Motor Circuits: All individual motor circuits with full load amperes ratings (FLA) of 480 amperes or less shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). Larger H.P. motors shall be protected by BUSSMANN Type KRP-C Low-Peak Time-Delay Fuses of the ratings shown on the drawings. All other motors, (such as 1.0 service factor motors) shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts) installed in ratings of approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 Dual Element Time Delay or Class L.
- D. Fluorescent fixtures shall be protected by BUSSMANN Fuses GLR or GMF installed in HLR Holder. They shall have individual protection on the line side of the ballast. A fuse and holder shall be mounted within or as part of the fixture. Size and type of fuse to be recommended by the ballast manufacturer.

2.02 SPARE FUSES

- A. Spare fuses shall be provided with a minimum of three of each ampere rating. See Section 26 50 00.01 for quantities of spare fusing required for ballasted light fixtures.

2.03 ACCEPTABLE MANUFACTURERS

- A. Bussman
- B. Little Fuse

PART 3 - EXECUTION

3.01 FUSES

- A. Install in all fusible devices provided under this Contract.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provided all disconnects, fused and unfused, required by code for equipment furnished under this and other divisions of these specifications and as shown on the drawings.

1.03 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Fused Disconnect Switches

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. General Electric
- B. Square-D
- C. Siemens
- D. Cutler-Hammer

2.02 DISCONNECTS

- A. Switch shall be heavy-duty type, shall be quick-break and shall be horsepower rated. Switch shall have blades as required to open all ungrounded conductors and shall be single throw unless noted.
- B. Enclosure shall have interlocking cover to prevent opening door when switch is closed. Door interlock shall include a defeating scheme, shall be padlockable in the "Off" position.
- C. Enclosure shall be suitable for environment in which mounted. All exterior enclosures shall have a minimum raintight rating.

2.03 FUSED SWITCHES (OR FUSED DISCONNECTS)

- A. Shall be as above with addition of fuse space and clips to accept only fuses as noted in Section 26 28 13.01.
- B. Fuses shall be sized in accordance with manufacturer's requirements of protected equipment.

2.04 NAMEPLATES

- A. Provide nameplates on all enclosures and include the following information: Load served, voltage, phase, panel and circuit number. Construct and attach in accordance with Section 26 00 00.01, Paragraph 2.5.

PART 3 - EXECUTION

3.01 SUPPORTS

- A. Secure solidly to wall or approved mounting frame. Disconnects supported only by Raceway are not acceptable.

3.02 SPLICES

- A. Wiring space within enclosure shall not be used as a junction box.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 26 00 00.01 – “General Electrical Conditions”
 - 2. Section 26 05 33.01 – “Raceway”
 - 3. Section 26 05 19.01 – “Wires and Cables”
 - 4. Section 26 24 19.01 – “Motor Controllers”
 - 5. Section 26 05 26.01 – “Grounding and Bonding”

1.02 DESCRIPTION

- A. This Section describes the materials and installation requirements for transient voltage surge suppressors (TVSS), alternatively called Surge Protective Devices (SPD). TVSS/SPD devices are used for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. This specification also describes the mechanical and the electrical requirements for the TVSS devices. The TVSS shall be suitable for application in both category A, B and C environments as described in ANSI/IEEE C62.41- 2002.
- C. The TVSS shall be of parallel design and provide individual protection components connected Line to Ground and Line to Line for Delta and High Resistance Grounded systems and Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems.
- D. Systems not providing discreet protection components in the above configuration will be rejected. A schematic diagram showing the configuration and technology of all internal connected components must be provided with submittals.
- E. The TVSS devices will be used both near electrical service entrance locations and at locations distant from service entrance locations (Panels, MCC's, Equipment Disconnects, etc.). For the purposes of this specification it should not be assumed that on Wye systems a neutral to ground bond will not be located electrically close to the suppressor location, thus discreet Neutral to Ground Suppression and Filter components are required.
- F. The Manufacturer/Vendor shall furnish all of the necessary TVSS/SPD products and related hardware (i.e. flush mounting kits, mounting brackets, etc.) as required for the installation of the Transient Voltage Surge Suppression (TVSS) / Surge Protective Devices (SPD) System suitable for the application.

1.03 QUALITY ASSURANCE AND PERFORMANCE

- A. Each complete suppression unit shall be UL1449 3rd Edition Listed as a Transient Voltage Surge Suppressor. UL 1449 test data for TVSS devices proposed, including UL let through voltage classification shall be provided with submittal. Units shall bear suppressed voltage rating issued by UL.
- B. Engineer reserves the right to have an employee or a representative designated by firm witness any testing required by this document. Vendor/manufacture shall provide written notice of

intent to test and shall coordinate testing with Engineer, should Engineer desire to witness tests.

- C. Performance & Durability Testing. Units shall be tested by an independent test agency in accordance with test procedures outlined in ANSI/IEEE C62.45, NEMA LS1 & UL1449. The following test data shall be provided:

1. Provide Maximum Surge Current (Single Pulse Rated, 8/20 μ S, by mode, Amperes) as per NEMA LS1-1992 – 2.2.9 with submittals document. Maximum surge current rating shall not be less than 120kA (60kA per mode including N-G) for branch panel models in low exposure areas, high exposure areas and for IEEE C62.41.1-2002 - Category B Switchboard and Motor Control Center Locations. Maximum surge current rating (per phase in applicable modes other than Neutral to Ground) shall not be less than 240kA (120kA per mode including N-G) for IEEE C62.41.1-2002 - Category C Locations, including all Electrical Equipment located at Service Entrance location. Provide proof of completion of such tests and test data with submittal data. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G & N-G) with submittals.
2. Provide durability test data utilizing the ANSI/IEEE C62.41-1991, Category C3, 20kV/10kA, 1.2 x 50 S - 8x20S combination waveform. Provide test data with submittals. Let through voltages shall be provided for all applicable protection modes (L-N, L-G & N-G) from zero reference. All TVSS/SPD devices (including branch panel) shall withstand a minimum of 5,000 hits delivered at a rate of one pulse per minute. Unit shall not fail or suffer let through voltage degradation of more than 7%. Lead length for testing and let through measurements shall be 6". Provide lead length used for testing with submittals.
3. Provide performance test data utilizing the ANSI/IEEE C62.41.2-2002, Exposure - High, 10kV/10kA, 1.2 x 50 μ S - 8x20 μ S combination waveform. Provide test data with submittals. Let through voltages shall be provided for all applicable protection modes (L-N, L-L & L-G) from zero reference. Lead length for testing and let through measurements shall be 6". Provide lead length used for testing with submittals.
4. Provide let through voltage test data and test waveforms used for (N-G) with the submittals for units intended for grounded Wye systems.
5. Provide let through voltage test data for the ANSI/IEEE C62.41.2-2002, Category B, 0.5 μ S-100 kHz 6kV/.5kA ring wave (L-L, L-N & L-G) with the submittals. Let through voltages shall be provided for all applicable protection modes and shall be measured from the zero reference.
6. Provide let through voltage test data for the ANSI/IEEE C62.41.2-2002, Neutral grounded at service entrance – Far Category, 0.5 μ S-100 kHz 3kV ring wave (N-G) with the submittals for units intended for grounded systems.
7. If available, test data shall be provided for the ANSI/IEEE C62.41.2-2002 level three category of the 5/50 nS EFT Burst waveform as a part of this submittal package. Let through voltages shall be provided for all applicable protection modes (L-L, L-N, L-G & N-G).
8. All TVSS/SPD tests must provide let through voltages using a positive polarity pulse at the 90-degree phase angle location on the sine wave for Category B and C waveforms and 180-degree for Category A waveforms. Let through voltages must be measured from the zero voltage reference line for the tests.
9. All let through voltage test results must be provided with a minimum of six inches of lead length as measured from the point where the wire would normally exit the TVSS enclosure

(standard installation) to the point of termination. Wire used for test must be of the type of building wiring material recognized by the latest adopted version of the NEC and must be readily available for wiring commercial buildings, unless permanently attached to and supplied with suppressor. Conductors sizing used for test shall be based on manufacturer's installation instructions for the proposed product.

10. The above test results, including oscillographs, test conditions, identity of the testing lab and the test technicians and engineers shall be provided as part of the submittal package. The manufacturer shall provide the contact phone number for a readily available factory engineer responsible for answering questions about this product and the tests performed. Information shall be provided in a format that is easily to analyze and review.
11. Maximum Let Through Voltages based on above requirements:

Peak Voltage Let Through Table Peak Let Through Voltages (measured from zero reference per NEMA LS-1) shall not exceed:						
Voltage & Configuration	Test / Wave	L-L	L-N	L-G	N-G	Phase Angle
480/277 Wye - Grounded	C3 – 20 kV/10ka	2500	1600	1900	1700	90
480/277 Wye - Grounded	B3 – 6 kV/3kA	1700	1000	1100	1000	90
480/277 Wye - Grounded	A1 – 2kV – 67A	150	150	150	150	180
480/277 Wye - Grounded	UL1449 Rev2 Update	1500	800	800	800	---
480 Delta	C3 – 20 kV/10ka	2400	N/A	2400	N/A	90
480 Delta	B3 – 6 kV/3kA	2000	N/A	1900	N/A	90
480 Delta	A1 – 2kV – 67A	75	N/A	1200	N/A	180
120/208 Wye	C3 – 20 kV/10ka	1400	1100	1300	1150	90
120/208 Wye	B3 – 6 kV/3kA	950	550	600	550	90
120/208 Wye	A1 – 2kV – 67A	100	75	120	100	180
120/208 Wye	UL1449 Rev2 Update	800	400	400	400	---
120/240 Split Phase	C3 – 20 kV/10ka	1400	1100	1250	1200	90

120/240 Split Phase	B3 – 6 kV/3kA	1000	600	600	600	90
120/240 Split Phase	A1 – 2kV – 67A	100	75	120	95	180

- D. Manufacturers Qualifications: Only firms regularly engaged in the manufacture of TVSS products for category C locations (ANSI/IEEE C62.41.1-2002), and whose products have been providing satisfactory service for not less than five years, shall be considered. A customer reference list, with a minimum of five contact names and current phone numbers shall be provided with the submittals. All manufacturer qualifications shall be provided as part of the submittal.
- E. The successful manufacturer/vendor shall assign a technical contact person for TVSS application, installation and warranty questions. This contact shall be available to provide a response to a technical question within a maximum of two business days.

1.04 CODES AND STANDARDS

- A. UL compliance and labeling: Listed per UL 1449, Third Edition.
- B. TVSS and Enclosures proposed and submitted shall be safety agency listed for all intended installations, meeting or exceeding all of the following: NEMA 1, 3R, 4, 12 & 13.
- C. TVSS device shall be designed to allow installation in accordance with latest adopted version of the National Electrical Code (NEC), National Electrical Safety Codes (NESC) and applicable OSHA 1910 requirements.
- D. NEMA LS1 (latest revision)
- E. IEEE Standard C62.41.1, IEEE Standard C62.41.2 & IEEE Standard C62.45 (latest revisions)

1.05 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Service Entrance TVSS/SPD
- B. Branch Panelboard TVSS/SPD

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The TVSS shall be compatible with the electrical system voltage, current, system configuration and intended applications.
- B. The TVSS maximum continuous operation voltage (MCOV) shall be capable of sustaining 115% of the nominal RMS voltage (with the associated peak voltage of $1.414 \times \text{RMS}$) continuously without degradation and heating.
- C. The TVSS shall only use clamping components connected in parallel with the supply to limit the surge voltages.
- D. Arc Discharge components, such as Gas Tube Arresters shall not be used as the sole protection component in any protection mode. Gas Tube Arresters may be used in conjunction with other components, such as MOV's and SAD's to provide protection. Where Gas Tube Arresters are installed, the circuit shall be specifically designed to prevent power follow current.
- E. Internal Fusing – If provided, shall be component level style:
1. Component Level Fusing

- a. Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable.
 - b. For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
 - c. Fusing shall be present in every mode, including Neutral-to-Ground.
 - d. The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied, providing a listed 200kAIC Short Circuit Current Rating (SCCR) without additional over-current protection.
- F. Status Indication & Monitoring: The suppressor shall include individual Phase Status LEDs, a red Service Required LED, an integrated Audible Alarm with silence button and Form C dry contacts (N.O. or N.C.) for remote monitoring capability. The form C contacts must be rated a minimum of 65VDC/150VAC with a load of 30WDC/60VA AC, and must be isolated and insulated from the ground plane and the power system to prevent Surges from reaching the monitoring system. The system shall provide insulation and isolation against any impressed voltages. Contacts shall be designed to change state upon device failure or loss of power.
- G. The protection should be housed in the appropriate NEMA rated, heavy duty powder coated steel enclosure. This enclosure must provide complete protection against personnel hazards and damage to equipment should a failure of the TVSS protection device occur. This enclosure shall also be designed to allow connection of the TVSS device without sharp bends in the conductors and lead lengths of less than 18" from the TVSS Lugs (or enclosure opening for devices with leads attached) to the final point of attachment to the power system for the application (assuming connection point is 12" from the exterior of the enclosure).
- H. Manufacturer shall provide a comprehensive warranty that provides for unlimited full replacement of a suppressor that is damaged or that fails to meet manufacturers published specifications and specifications provided within, without pro-rating value. Warranty shall provide coverage for a minimum period of 20 years for individual units (standard warranty) and. Series SPDs shall be covered for 10 years. These Unlimited Replacement Warranties cannot exclude system overvoltages or direct lightning strike events. Warranty shall not require any factory or third party testing. Warranty shall apply to installed unit(s) for the duration of the warranty period no matter who owns the facility or equipment. All warranty information and copies of warranty documents must be provided with this response.
1. All replacements shall be of same make, model and configuration as original unit unless otherwise requested or approved by customer.
 2. The manufacturer/vendor shall provide a warranty replacement unit at the facility within 5 days of receipt of written notification that the TVSS unit has failed, at no cost to the Port.
 3. If the manufacturer/vendor requires inspection of the installed unit to validate warranty claim, the manufacturer/vendor must visit the site where the failed TVSS device(s) are located within 3 days of notification. This visit will be performed at no cost to customer. This section does not modify the requirement for the TVSS replacement to be within 5 days of written notification as described in section G, above.

4. The replacement unit shall be sent to the facility without shipping, handling, examination or other fees.
- I. Complete, comprehensive installation instructions shall be provided for the TVSS systems proposed. Installation instructions must provide for compliance with latest adopted NEC requirements and UL listing requirements, while not degrading performance of TVSS device as tested. Provide copies of installation instructions for the models proposed with the specification response. Successful vendors/manufacturers shall provide a complete, comprehensive installation checklist.
- J. If manufacturer claims TVSS device to have filtering capabilities, provide complete information on filtering performance of TVSS device with specification response. This information must include attenuation across a stated frequency range. If the TVSS is a UL 1283 listed device, the manufacturer shall provide all performance specifications for filter attenuation.
- K. Provide complete enclosure dimensions (H*W*D) and cutsheets indicating dimensions including locations of terminations and wire entry locations with specification response.
- L. Provide UL Short Circuit Current Ratings (SCCR). Minimum ratings shall be 200kAIC without additional/external over-current protection.
- M. Manufacturer shall make available metal flush plates for distribution and branch panel SPDs. The flush plate shall provide for a clean architectural finish and be utilized where the attached panel is mounted flush.
- N. Manufacturer must have knowledgeable local representation and distribution within 100 miles of the project location and must be willing to provide technical support, warranty claim support, and installation support for the project.
- O. Successful manufacturer/vendor must be capable of supplying TVSS for project within 20 days of receipt of order for orders of 25 units and less for models submitted in response to this specification.

2.02 SERVICE ENTRANCE

- A. Transient Voltage Surge Suppressors shall be installed at all service entrances of each building and as shown on the riser / one-line diagram. Suppressors shall be listed in accordance with UL 1449 3rd Edition, Standard for Safety, Transient Voltage Surge Suppressors.
- B. For 3-phase, 4-wire plus ground configurations, suppressors shall provide suppression and filter elements between each phase conductor and the system neutral, each phase conductor and the system ground and between the neutral conductor and ground.
- C. Suppressors shall include a passive circuit that allows the suppressor to actively follow the voltage waveform and provide a clamping envelope that follows the sine wave to limit low level IEEE C62.41 A1 ring waves (of either polarity) at all locations on the sine wave. This circuit shall also perform in the Neutral to Ground Mode where a sine wave does not exist. Details of circuit used to provide this function and information detailing and quantifying the performance of this circuit (in all modes with Category A1 ring wave) shall be provided with specification response. All Let Through Voltage (LTV) values shall not exceed those stated in section 1.04.C.11.
- D. Indication of proper suppressor connection and operation shall be provided, consisting of status LEDs for each phase, a Red Service Required LED and an internal Audible Alarm with silence/mute button. Dry contacts (NO/NC) are required for external monitoring.
- E. SPD shall exhibit fully redundant protection for each phase.

- F. The surge suppressor shall be of parallel design and shall be capable of being removed and replaced without disrupting electrical service to the facility.
- G. Suppressors shall consist of solid-state components and shall operate bi-directionally.
- H. All surge protective devices shall be of the same manufacturer.
- I. The minimum single impulse current rating (as per NEMA LS-1) shall not be less than 240,000 amperes per phase (120KA per mode). Provide proof of compliance by supplying certified test results from independent test lab with submittals.
- J. Maximum size of TVSS/SPD units for Primary, Service Entrance applications is 15.5"x12.3"x8.25".

2.03 SECONDARY SUPPRESSORS FOR MCC, DISTRIBUTION & BRANCH PANELS

- A. Transient Voltage Surge Suppressors shall be installed at all service entrances of each building and as shown on the riser / one-line diagram. Suppressors shall be listed in accordance with UL 1449 3rd Edition, Standard for Safety, Transient Voltage Surge Suppressors.
- B. For 3-phase, 4-wire plus ground configurations, suppressors shall provide suppression and filter elements between each phase conductor and the system neutral, each phase conductor and the system ground and between the neutral conductor and ground.
- C. Suppressors shall include a passive circuit that allows the suppressor to actively follow the voltage waveform and provide a clamping envelope that follows the sine wave to limit low level IEEE C62.41 A1 ring waves (of either polarity) at all locations on the sine wave. This circuit shall also perform in the Neutral to Ground Mode where a sine wave does not exist. Details of circuit used to provide this function and information detailing and quantifying the performance of this circuit (in all modes with Category A1 ring wave) shall be provided with specification response. All Let Through Voltage (LTV) values shall not exceed those stated in section 1.04.C.11.
- D. Indication of proper suppressor connection and operation shall be provided, consisting of status LEDs for each phase, a Red Service Required LED and an internal Audible Alarm with silence/mute button. Dry contacts (NO/NC) are required for external monitoring.
- E. SPD shall exhibit fully redundant protection for each phase.
- F. The surge suppressor shall be of parallel design and shall be capable of being removed and replaced without disrupting electrical service to the facility.
- G. Suppressors shall consist of solid-state components and shall operate bi-directionally.
- H. All surge protective devices shall be of the same manufacturer.
- I. The minimum single impulse current rating (as per NEMA LS-1) shall not be less than 120,000 amperes per phase (60KA per mode). Provide proof of compliance by supplying certified test results from independent test lab with submittals.
- J. Maximum size of TVSS/SPD units for Secondary Suppressors for MCC, Distribution & Branch Panel applications is 15.5"x12.3"x8.25".

2.04 PRIOR APPROVALS

- A. The following manufacturer(s) have submitted the required information and have been reviewed and approved for this project:

Total Protection Solutions SPD/TVSS by Thomas & Betts Power Solutions

DIVISION 26 - ELECTRICAL
SECTION 26 43 00.01 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)/SURGE PROTECTION DEVICE (SPD)

<u>Voltage Location</u>	<u>480Y277v</u> 3 Phase Bonded Wye	<u>480v</u> 3 Phase Delta	<u>208Y120v</u> 3 Phase Bonded Wye	<u>208v</u> 3 Phase Delta	<u>120/240v</u> Single / Split Phase	<u>120v</u> Fire Alarm, Security, PLC, etc.
Main Services	ST240-3Y480-FL	ST240-480NN-FL	ST240-3Y208-FL	ST240-240NN-FL	ST240-1S240-FL	N/A
Distribution MCC & Branch Panels	LP120-3Y480-FL	ST120-480NN-FL	LP120-3Y208-FL	ST120-240NN-FL	LP120-1S240-FL	N/A
Dedicated Equipment	N/A	N/A	N/A	N/A	N/A	LTE120-30A
TVSS/SPD Applications Notes: 1. Use <u>60 Amp</u> Circuit Breakers for Service Entrances and <u>30 Amp</u> Circuit Breakers for Distribution, MCC & Branch Panel applications. 2. Use Delta units for unbonded/ungrounded and high resistance ground Wye applications.						

Innovative Technology Protector by Eaton/Cutler Hammer						
<u>Voltage Location</u>	<u>480Y277v</u> 3 Phase Bonded Wye	<u>480v</u> 3 Phase Delta	<u>208Y120v</u> 3 Phase Bonded Wye	<u>208v</u> 3 Phase Delta	<u>120/240v</u> Single / Split Phase	<u>120v</u> Fire Alarm Security, PLC, etc.
Main Services	PTE240-3Y201-L-SD	PTE240-N400-L-SD	PTE240-3Y101-L-SD	PTE240-NN201-L-SD	PTE240-1S101-L-SD	N/A
Distribution MCC & Branch Panels	PTE120-3Y201-L-SD	PTE120-N400-L-SD	PTE120-3Y101-L-SD	PTE120-NN201-L-SD	PTE120-1S101-L-SD	N/A
Dedicated Equipment	N/A	N/A	N/A	N/A	N/A	LTE120-30A

PART 3 - EXECUTION

3.01 GENERAL

- A. Suppressors shall be installed per the manufacturer's installation instructions and the requirements of: the NEC, the local authority having jurisdiction and the engineer.

- B. Size overcurrent protective device and conductors per manufacturer's recommendations and NEC requirements.
- C. The Engineer may perform inspection of the installed suppressors and reserves the right to require corrections to the installation to comply with manufacturer's installation requirements and project specifications.
- D. The SPD/TVSS supplier must provide on-site installation training for the electrical contractor.

3.02 SERVICE ENTRANCE

- A. Install one primary suppressor at each utility service entrance to the facility as indicated on the drawings.
- B. Suppressor shall be installed on the load side of the service entrance disconnecting means in accordance with NEC requirements.
- C. Provide a 60 Amp circuit breaker (with a safety clip to ensure the circuit breaker cannot be inadvertently turned off) in the switchboard as over-current protection for the wire and as a disconnecting means for the SPD (or as specified by the manufacture).
- D. Use minimum #6 AWG wire for connecting the SPD.
- E. Conductors between suppressor and point of attachment shall be kept as short and straight as possible. Lead length of connecting conductor shall not exceed two (2) feet without written permission of the specifying Engineer.
- F. Over-length SPD leads (greater than 24") must be twisted together (1 twist/foot) and securely tie-wrapped once per foot to reduce impedance of the leads.
- G. SPD leads may not be spliced.
- H. Suppressor's ground shall be bonded to enclosure frame and the service entrance ground bus, and conduit between the TVSS/SPD and the switchboard must provide secure electrical/mechanical connections.

3.03 SECONDARY SUPPRESSORS FOR MCC, DISTRIBUTION & BRANCH PANELS

- A. Install one secondary suppressor at each MCC, Distribution Panel, Branch Panel & Sub-Panel location as indicated on the drawings.
- B. Provide a 30 Amp circuit breaker (with a safety clip to ensure the circuit breaker cannot be inadvertently turned off) in the panel being protected as over-current protection for the wire and as a disconnecting means for the SPD (or as specified by the manufacture).
- C. Conductors between suppressor and point of attachment to the panelboard shall be kept as short and straight as possible. Mount the TVSS directly adjacent to the circuit breaker closest to the neutral bus, such that the maximum length of connecting wiring is kept as short as possible, not exceed 18 inches for all phase and neutral leads (24" for ground lead on IG panels).
- D. Over-length SPD leads (greater than 18") must be twisted together (2 twists/foot) and securely tie-wrapped once per foot to reduce impedance of the leads. Quality compression butt-splice connections are required when extending SPD leads (wire nuts are not acceptable).
- E. Grounding for all non-IG installations: Suppressor's ground lead shall be bonded to the panel enclosure with a small ground lug as close as possible to the TVSS mounting point. Conduit between the TVSS/SPD and the switchboard must provide secure electrical/mechanical connections.

- F. Multiple "Feed-Through" Panels with shared SPD/TVSS units must be immediately adjacent to each other (side by side) with short tie cables not to exceed 36". Sub-panels must be feed from a primary panel with a "lug-out", lug-in" tie connection, and the tie connection lugs must be at the same end of the primary and sub-fed panel. i.e. bottom to bottom or top to top to ensure short tie "sub-feed" cables.
1. Dual Panel Configurations: One SPD/TVSS per two panels
 2. Three and Four Panel Configurations: One SPD/TVSS installed on both outside panels of the multi-panel configuration, i.e. Install SPD on first (primary) and another one on the third or fourth sub-fed panel for a total of two SPDs.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 WORK INCLUDED

- A. Provide the lighting system complete and operational.
- B. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling.

1.03 FIXTURE SCHEDULE MANUFACTURER'S SERIES NUMBERS

- A. Are a design series reference and do not necessarily represent the number, size, wattage or the type of lamp, ballast or special requirements as specified hereinafter.

1.04 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Complete LED Lighting Fixture as listed on Electrical Drawings E1.00.
- B. When substitute fixtures are submitted (if permitted) the data shall clearly cross reference (written or highlighted) that the substitute fixture complies with every detail of the specified fixture. Fixtures not fully complying with contract documents are not permitted.

PART 2 - PRODUCTS

2.01 METAL PARTS

- A. Interior Fixtures: Steel or aluminum with 300°F, baked enamel finish, brushed aluminum with baked acrylic clear lacquer finish, or stainless steel with a brushed finish, manufacturer's standard color unless specified otherwise.
- B. Exterior Fixtures: Corrosion resisting metal, a (non-ferrous, stainless steel or special finish) and in all cases suitable for outdoor service without tarnishing or other damage due to exposure; manufacturer's standard colors unless specified otherwise; cadmium plate all metal parts concealed by canopies, including screws, plates and brackets. All exposed fasteners shall be tamperproof.
- C. Recessed Type: Incandescent fixtures shall have housing containing an integral thermal device pursuant to NEC 410-65C.

2.02 LIGHT TRANSMITTING COMPONENTS

- A. Virgin acrylic plastic (0.125-inch thick overall minimum) or glass. Shall be contained in a steel frame hinged and which remains attached to the fixture when door is in open position.

2.03 SPECIAL PARTS

- A. Adapters, Plates, Brackets and Anchors: Provide where required by construction features of the building to suitably mount lighting fixture. All such appurtenances and mounting methods shall be approved by the Engineer prior to fabrication and installation.

2.04 SOLID STATE LIGHTING FIXTURES (LED)

- A. Fixtures shall provide lighting with a minimum Correlated Color temperature (CCT) of 4000K and shall have a Color Rendering Index of (CRI) of 70 or higher. Verify performance of the light producing solid state components by a test report in compliance with the requirements of IESNA LM 80. Verify performance of the solid state light fixtures by a test report in compliance

with the requirements of IESNA LM 79. Provide lab results by a NVLAP certified laboratory. The light producing solid state components and drivers shall have a life expectancy of 50,000 operating hours while maintaining at least 70% of original illumination level. Provide a complete five year warranty for fixtures.

2.05 HANGING FOR PENDANT FIXTURES

- A. Rigid type, with not less than 5 thread engagement at each end, consisting of iron pipe, with brass or aluminum tubing casing, or painted tubing not less than 0.040 inches thick.
- B. Provide a canopy for each fixture hanger except where fixture conceals the outlet box directly without a canopy.
- C. Provide a safety chain for all glass pendant fixtures and for all fixtures mounted in gymnasiums.

2.06 EXIT SIGNS

- A. Fronts: Cutout stencils made of minimum #20 gauge sheet steel or sheet aluminum with red glass or plastic back of the cutout. Mount fronts either on concealed hinges or pull-out type with chain catch. Removable cutout arrows shall indicate direction of travel.

PART 3 - EXECUTION

3.01 LIGHTING FIXTURES - GENERAL

- A. Size and mounting height from finished floor to bottom of fixture as indicated on the drawings. Verify mounting provisions prior to the ordering of fixtures. Fixtures shall be UL listed for the location, and application in which they are installed.
- B. Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations.
- C. Recessed fixtures installed in seismic areas shall be installed utilizing specially designed seismic clips.
- D. Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.02 DIFFUSERS AND ENCLOSURES

- A. Install lighting fixture diffusers only after construction work, painting and clean up are completed. Prior to final acceptance, remove all lamps, reflectors and diffusers, wash, rinse and reinstall.

3.03 ADJUSTMENT OF FIXTURES

- A. Make all final spotlight and adjustable light settings under the direction of the Engineer during a scheduled period of time prior to the completion of the project. Include costs for all equipment and personnel expenses required for adjustment.
- B. For fixtures with indirect lighting, notify Engineer prior to installation of any circumstance where the fixture lamp source will be within 12" of ceiling.

3.04 SUPPORT OF LED FIXTURES

- A. Recessed Troffer Type: For fixtures supported by the ceiling suspension system, provide integral tabs, which rotate into position after fixture is lifted into the ceiling cavity. Provide two safety chains secured to structural members above suspended ceiling. Circuit connection shall

be through use of 60-inch flexible conduit from a rigidly supported junction box. For plaster or GWB ceilings, provide a plaster frame compatible with light fixture.

- B. Recessed Downlight Type: Mount in frames suitable for the ceiling, with the recessed portion of the fixture securely supported from the ceiling framing. For fixtures supported by a ceiling suspension system, provide two safety chains secured to structural members above suspended ceiling.
- C. Surface and Pendant Mounted Type:
 - 1. Where mounted on accessible ceilings, hang from structural members by means of hanger rods through ceiling or as approved.
 - 2. Where ceiling is of insufficient strength to support weight of lighting fixture, provide additional framing to support as required. Fixtures shall be supported from structure with seismic bracing independent of ceiling.
 - 3. For Pendant Mount Type: Provide a unistrut channel for mounting fixtures entire fixture length unless light fixture is designed specifically for supporting itself. Provide 3/8-inch thread rod secured to structural members for support of unistrut channel.
 - 4. Continuous Runs of Fixtures: Straight when sighting from end to end, regardless of irregularities in the ceiling. Where fixtures are so installed, omit ornamental ends between sections.

3.05 LOCATION

- A. Mount to the dimensions shown on the drawings. Mount at quarter points where no dimensions appear. Engineer shall specify mounting locations where no dimensions appear and quarter point mounting is impractical or not indicated on the drawings.
- B. Refer to details, mechanical drawings, and coordinate with mechanical equipment and ductwork mounted in ceilings to prevent conflict with light fixtures prior to installation.

3.06 SPARE FIXTURES

- A. Provide the following spare devices:

<u>Item</u>	<u>Quantity</u>
EX-1	2

- B. Spare fixtures shall include 100 feet of conduit, wire, miscellaneous appurtenances, and all labor, as required for a complete installation. Location of these units to be determined by the Engineer at the site. Unused devices shall be turned over to the Engineer.

3.07 FIXTURE TENTING

- A. Contractor shall coordinate ceiling types with architectural drawings and specifications and provide equivalent fire rated enclosures above all light fixtures which penetrate rated ceilings.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SCOPE AND RELATED DOCUMENTS

- A. The work performed under this specification shall be of good quality and performed in a workmanlike manner. In this context "good quality" means the work shall meet industry technical standards and quality of appearance. The Contractor shall make all corrections as needed, to the satisfaction of the Engineer.
- B. Applicable Standards: All work shall be performed in accordance with the latest revisions of the following standards:
 - 1. International Building Code (latest edition).
 - 2. International Fire Code (latest edition).
 - 3. NEC (National Electrical Code) (latest edition).
 - 4. Telecommunications Architectural Standards - In Washington State Government (latest edition).
 - 5. ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications.
- C. Low Voltage Contractor shall possess a current and valid Washington State 06 Electrical Low Voltage License.

1.03 QUALITY ASSURANCE

- A. Device or wiring arrangement shown on the drawings represents the intent of the system. If additional equipment (that may not be shown) is required to make a fully functional system, then provide such equipment as required.
- B. Each specification section that is governed by these specifications shall be provided, installed, commissioned, and warranted by a Contractor that meet the following requirements for the equipment manufacturer that is being submitted for:
 - 1. All equipment for EACH Specification Section shall be provided and installed by a single supplier.
 - 2. Have installed a minimum of three (3) Systems within the past five (5) years.
 - 3. Maintain a 24 hour emergency service program using Manufacturer Trained technicians, shall respond to service calls within 24 hours during and after the warranty period.
 - 4. The Contractor shall be Manufacturer Approved to purchase the equipment, have a local office staffed with Manufacturer Certified installers that are capable to maintain, service, and warrant the equipment being installed, who are full-time employees and are capable of programming, testing, inspecting, maintaining, warranting, inventorying parts for the life of the system, and shall be located within a 100-mile radius of the project site.
 - 5. Offices that require staff from another "Branch Office and/or Company Office" outside of this radius, are not acceptable.

1.04 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals and Shop Drawings shall be provided for EACH Low Voltage System Specification Section Number and shall contain, but not be limited to the items listed below:
 - 1. Terminal Cabinets
 - 2. Terminal Strips
 - 3. Enclosures
 - 4. Labels
 - 5. System Cables
- B. Additional Shop Drawing Requirements:
 - 1. For additional shop drawing requirements, refer to EACH Low Voltage System Specification Section Number, in addition to what is listed below.
 - 2. Legend Information: From Left to Right, provide the following information for EACH device:
 - a. Use the symbol on the Legend of the contract drawings.
 - b. List the manufacturer's name.
 - c. List the manufacturer's model number.
 - 3. Provide a logical description of the device.
 - a. Provide the back box requirements and related information. At a minimum, this shall include;
 - 1) The height, width, and depth of each required back box for each symbol on the legend.
 - 2) If the device is a back box or comes with a back box (IE: control panel, power supply, enclosure, etc.) then provide the height, width, and depth of the dimensions.
 - 3) Indicate if this device back box is going to be installed flush, semi-flush, or surface mounted.
 - 4. Provide a Wire Legend listing the cable manufacturer, model number, cable rating, size of conductors, quantity of conductors, and color of each conductor. Use the format in the Sample "Wire Legend", as it applies to each system (see the Sample at the end of this specification). Provide a cable identification naming scheme (as defined within these specifications).
 - a. The Wire Legend shall include the Cable Manufacturer and Model Number for EACH of the following types of cables (as applicable to the project):
 - 1) Conduit/Raceway Cable
 - 2) Open Cabling
 - 3) Wet Rated Cable
 - 4) Aerial Rated Cable
 - 5) EACH cable and EACH cable type shall have a different letter designation.

5. Load and Battery Calculations: For EACH control Panel, Power Supply, and/or Amplifier for EACH System, at a minimum show the following Amp Draw, Circuit, and Battery calculations;
 - a. The total Amp Draw load in stand by or non-active mode.
 - b. The total Amp Draw load with all devices active and in a maximum load condition.
 - c. Provide the spare power information that is available for future additional devices and/or equipment.
 - 1) Include the quantities of spare circuits that are available (where applicable).
 - d. Circuit calculations:
 - 1) The quantity of each device per circuit.
 - 2) The Amp Draw per device per circuit (where applicable [this is not applicable to addressable devices that receive their power from an addressable data loop. Simply include the maximum amount of devices than can be placed on each addressable loop and the amount of addressable devices that are included on each addressable loop for this project]).
 - 3) The total Amp Draw load per circuit.
 - 4) The cable length distance of each circuit.
 - 5) The gauge size of wire used for each circuit.
 - 6) The total line loss for each circuit.
 - 7) Factor the line loss and Amp Draw to show the actual voltage available at the end of each circuit (after the last device).
 - 8) Include in the design layout, the requirements of "Spare Capacity" in Part 2 of this specification (where applicable).
 - e. Battery Back Up:
 - 1) All Batteries shall be sized to provide at least 20% spare capacity. Include this information in all calculations.
 - 2) For Fire Alarm, include all calculations that are required by the Authority Having Jurisdiction.
 - f. Uninterruptible Power Supply(s) (UPS):
 - 1) For systems that include a UPS, provide the maximum load (allowed by the UPS manufacturer) that EACH UPS is capable of providing, and list each item and its maximum load that will be connected to the UPS. Include the total load of all equipment connected to the UPS, and list the spare capacity available.
6. Riser Diagram: Provide a System One-Line Riser Diagram that shows the entire system. List the following:
 - a. List the head-end equipment and IP addressed devices. Show the connection to the "Cloud" WAN, where applicable.
 - 1) Show each location (the MDF and EACH designated IDF separately).
 - 2) Show each cable types, sizes, and quantities between the MDF and each designated IDF location.

- 3) Show EACH device in the MDF and each designated IDF location (Control Panel, CPU, DVR, Server, Power Supply and Terminal Cabinet [where applicable]) for each applicable system, the room name that each major system component is located in, and show the connection to the headend equipment.
 - 4) Show all field devices with their respective room names and/or room numbers and connections to their associated equipment.
 - 5) Show all field devices with their respective address point (where applicable).
7. For the Fire Alarm System ONLY, provide a detailed Sequence of Operation matrix that meets or exceeds industry standards, and shows how the System will work. This includes, but is not limited to:
 - a. All Inputs and/or Actions:
 - b. All Outputs and/or Controls:
8. Provide all Mounting Details and mounting heights for:
 - a. All head-end equipment.
 - b. Rack(s) (where applicable).
 - c. Device(s).
9. Detailed Wiring Information:
 - a. Show each individual conductor color for all wiring on the point-to-point wiring diagrams for each device.
 - b. Show complete scale drawings of equipment, devices, wiring diagrams, and terminations of:
 - 1) Each Control Panel, CPU, DVR, etc.
 - 2) Power Supply and/or amplifier
 - 3) Rack equipment (where applicable).
 - 4) EACH device type
 - 5) EACH Terminal Cabinet (where applicable)
10. Rack Layout (where applicable).
 - a. Show the intended equipment layout within the Rack(s).
 - b. Show blank filler plates in spaces where equipment is not installed.
 - c. Indicate the rack unit size of each device or filler plate in the rack.
 - 1) If rack equipment is installed on the rear side of the rack, show rear view of the rack also.
11. The matrix as defined in the 'System Device Naming Matrix' of each system specification (where applicable).
12. On the shop drawings, include a letter signed by the System designer that is responsible for the design depicted in the submittals and on the shop drawings. The letter shall state that the equipment and shop drawings design conform to national, state, local codes as adopted by the local authority having jurisdiction, and meet or exceed all of the performance requirements as outlined in the specifications.

- a. Designers shall provide the following:
 - 1) Provide a "signature" line and signature of the designer.
 - 2) Provide a "printed name" line, below [or to the right] of the signature line and the printed name of the designer.
 - 3) Provide a "date" line, below [or to the right] of the printed name line and date of the design.
 - b. For Fire Alarm Shop Drawings, include the above information and the system shall be designed by one of the following (provide a copy of the supporting documentation):
 - 1) NICET Level III Certified Designer
 - 2) Registered Professional Engineer.
13. Label and Labeling:
- a. On the drawings, label each Rack, Control Panel, CPU, DVR, Power Supply(s), and Terminal Cabinet(s) in a logical numeric sequence. (i.e. for Fire Alarm Power Supplies, list them as FAPS-1, FAPS-2, etc).
 - b. Cables: Generate an alpha-numeric label for each cable type and cable run.
 - c. For projects with multiple sites, all labeling shall be consistent for all sites.
14. Show floor plan layout of devices and the anticipated routing of cable runs in parallel with all structural framing in a neat and orderly fashion.
15. EACH device at EACH location shall be shown on EACH floor plan. The cabling for EACH device shall be shown from EACH device to the device that it shall be connected to. EACH cable(s) shown on the floor plan shall be identified as described in the "Wire Legend" portion listed within this specification.
- a. Floor Plans: Show all system related devices and all equipment that the system specific shop drawings will interface to, on each of the floor plans. Provide Cabling for each device and the related wire type (as shown on the "Wire Legend") shown for each of the device(s). Where multiple devices are on the same circuit or an addressable data cable is used, show all devices and their related cable(s).
16. EOL Supervision:
- a. Indicate on the floor plan drawings where EACH of the End-Of-Line Resistor(s) is located (where applicable).
17. Addressable Device information:
- a. Show each device address next to each device (where applicable), and clearly displaying this information so that it is not confusing as to which address belongs to which device. For non-addressable devices that will be connected to an addressable module, show the device address next to each device and the addressable module that it will be connected to.
 - b. List the System Address Point(s) using a logical numbering sequence for the devices on a single run.
 - c. Maintain the "Spare Capacity" requirements listed elsewhere in the specifications (where applicable).

- d. Include the complete Dip Switch and/or Rotary Addressing Scheme (used to set the device address for each addressable point) on the drawings.
- C. Contract drawings shall not be used as Shop Drawings.
- D. The Shop Drawings shall be system specific. For example: only Fire Alarm equipment and connections to other equipment that will be interfaced to the Fire Alarm, shall be shown on the Fire Alarm drawings.

1.05 GOVERNING CODES AND CONFLICTS

- A. If the requirements of this section, related sections or the Project Drawings exceed those of the governing codes and regulations, then the requirements of this section, related sections, and the Drawings shall govern. However, nothing in this section, related sections or the Drawings shall be construed to permit work not forming to all governing codes and regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide all equipment as defined in each specification and on the drawings.
- B. All equipment, panels, power supplies, and devices shall be manufactured under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label.
- C. All equipment for each system shall bear the UL label. Partial or pending listings shall not be acceptable. It shall be the Contractor's responsibility to insure that these requirements are met, and replace any and all equipment up to and including the entire system, if these requirements are not met.
- D. EACH of the specified Low Voltage Systems identified in PART 1 of these specifications including the design, devices and/or wiring arrangement shown on the drawings, represent that based on various equipment manufacturers. Any changes resulting from differences between the specified product and other manufacturers or substitute manufacturers, shall be the responsibility of the Contractor.
- E. Refer to PART 1 for any equipment that is not specifically defined.

2.02 CONDITION OF MATERIAL

- A. All equipment shall be new, in un-opened boxes, and be the most current model available for each component and/or device that is provided for this project. For products that use firmware, the most current version available shall be downloaded and installed at each component and/or device, prior to any programming being performed.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. All materials shall be in working order as intended by the manufacturer, at the completion of the project.

2.03 TERMINAL CABINETS, TERMINAL STRIPS, AND ENCLOSURES

- A. On-Site System Information Binder and Enclosure: EACH Specification Section identified on the first page of this specification shall have an Information Binder that shall be housed in a System Information enclosure. The enclosure shall have a hinged door with the text "(Section Title here) Information", with each specific system name silk screened onto the enclosure door, and shall bear the Underwriters' Laboratories "UL" label. A "T-Turn" cam lock shall be used to keep the enclosure door closed, and a key shall NOT be required to open the enclosure. Use the following Space Age Electronics model number, or approved equal.

1. All Systems (other than Fire Alarm): Model # YD9048DBXAA. Verify with the Engineer the color of the enclosure(s) prior to ordering the enclosure. There shall be no additional charge to the Port, for changes to the color of the enclosure.
 2. For the Fire Alarm: Model # YD9049DBXAA shall be Red in color, have a hinged door, and have "Fire Alarm System Documentation" silk screened on the enclosure door.
- B. Terminal Cabinets (TC):
1. See EACH Specification for Terminal Cabinet requirements (where applicable).
- C. Terminal Strips:
1. See EACH Specification for Terminal Strip requirements (where applicable).
- D. Enclosures:
1. Each Systems Control Panel(s), Power Supply(s), TC(s), and other metal enclosures shall have the following:
 - a. Use key operated locks to secure the enclosure (keyed so that a single key can lock and unlock all enclosure locks for the entire system), and provide ten (10) keys.
 - b. Use some form of wire management that uses permanently secured fasteners (no double back tape), and uses reusable and adjustable Velcro style cable straps, which shall be installed approximately every four inches within each enclosure.

2.04 LABELS AND LABELING

- A. The alpha-numeric labeling shall be developed by the Contractor.
- B. Label all equipment and cables in an identical fashion of a sequential manner.
- C. The Contractor proposed alpha-numeric labeling that is intended to be used to identify all components of the system shall be submitted for approval by the engineer, with the submittal of equipment data sheets.
- D. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- E. Phenolic name plates shall be used for identification of the Racks, Control Panel(s), Power Supply(s), Terminal Cabinet(s), and other appurtenances of each system in a logical numeric sequence. Use an alpha-numeric name of each device for each location to identify the equipment on the Shop Drawings.
1. The size of the plate shall be two-inches high by approximately eight-inches wide. Different colors of backgrounds may be used for each System (but Red shall only be used for Fire Alarm).
 2. The text color shall be White Letters that are 3/4-inch high and are 1/2-inch in width.
- F. Labeling of Cables must be provided in the following locations: EACH System Control Panel, Power Supplies, Terminal Cabinets, Terminal Strips, Racks, other system related appurtenances, and all junction boxes. Label all cables as shown on the Contractor's Shop Drawings.
- G. All label printing shall be machine generated using indelible ink ribbons or cartridges, self-laminating labels shall be used on cable jackets, appropriately sized to the outside diameter of the cable, and placed within view at the termination point on each end.
1. Temporary Labels: Shall consist of the following:

- a. Using a fine point permanent style marker, Sharpie® or equivalent, to write directly onto the outer jacket of the cable or use temporary tags.
 - b. The Contractor shall take all precautions to use care when pulling the cable to insure the integrity of the temporary label.
 - c. Remove all temporary labels and tags, prior to installing the permanent label.
2. Permanent Labels: Labels shall be produced using an electronic labeler. Cabling shall be marked with a permanent, electronic printed label with a self-laminating clear wrapping to cover the printed label, and shall be secured to the outer jacket of the cable.
3. Provide Brady Model XSL-116-427 or approved equal.

2.05 SYSTEM CABLES

- A. All cable(s) shall be new.
- B. All cable types shall be rated to meet all code requirements for site conditions, including, but not limited to; underground, wet, plenum, and aerial requirements as mandated per N.E.C. and local AHJ requirements. The Contractor shall be responsible for insuring that all cables meet all national codes, state codes, local codes, AHJ requirements, and each equipment manufacturer's requirements, for a reliable, fully functional, and warrantable system, as intended. Do not exceed the wiring distance limitation of the equipment, device(s), cable(s) and/or conductor(s) as recommended by the manufacturer of either the equipment and/or the cables for each installation application:
1. Use the manufacturer recommended cables for EACH application and as required by Code (i.e. Raceway, Open Cabling, Wet and/or Aerial).
 2. All cables shall be stranded, unless otherwise noted and/or recommended otherwise in writing by the manufacturer.
 - a. CAT5 through CAT7 cables are excluded.
 3. See PART 3 of this section, and of each System specification for more information.

2.06 PROOF OF DELIVERY FORM

- A. When providing Equipment to the Port, the Contractor shall provide the following transmittal document and obtain the necessary signatures.
1. The Contractor's Transmittal Document is defined as:
 - a. Company logo.
 - b. Name.
 - c. Address.
 - d. Telephone number.
 - e. Delivery date.
 - f. Contractor's name that is making the delivery.
 - g. Quantity of each item.
 - h. Manufacturers Name and Model Number.
 - i. The exact same description of the device (as used on the shop drawings).
 - j. Provide a "signature" line for the Engineer.

- k. Provide a "printed name" line, for the Engineer.
- l. Provide a "date" line, below for the Engineer.

PART 3 - EXECUTION

3.01 WORK ENVIRONMENT

A. General:

- 1. The Contractor shall have implemented an OSHA approved safety plan at their place of business, and is a daily practice for all staff.
 - a. Avoiding an injury is the primary concern for this project. Use OSHA industry standards to avoid accidents.
- 2. Coordination with Other Trades:
 - a. It is the responsibility of the Contractor to coordinate with all trades for this project. Maintain all requirements for; project schedule deadlines, rough in, installation, programming, training, and insuring that the Port receives a fully functional system as defined in this specification.

3.02 APPROVED EQUIPMENT AND PERMITS

- A. No equipment shall be delivered to the job site until shop drawings have been reviewed and approved by the Engineer.
- B. An approved set of shop drawings shall be continuously available at the job site during construction, for review by the Engineer.
- C. Obtain all permits as required, prior to installation of any equipment. They shall be continuously available at the job site during construction, for review by the Engineer.

3.03 CABLE INSTALLATION – GENERAL

- A. Open Cable installation methods are acceptable for this project when they are above accessible ceilings or in attic spaces, provided that all requirements identified in this specification are met.
- B. All cable types shall be rated to meet all code requirements for site conditions, including, but not limited to; underground, wet, and aerial requirements as mandated per N.E.C. and local AHJ requirements.
- C. Do not exceed the wiring distance limitation of the equipment, device(s), cable(s) and/or conductor(s) as recommended by the manufacturer of either equipment and/or cables for each installation application. The Contractor shall be responsible for insuring that all cables meet all equipment manufacturers' requirements for a reliable, fully functional, and warrantable system, as intended.
- D. Wiring insulation shall be one of the types required by NEC 725-16.
- E. Cable Supports: Clamps, "D-Rings", "J-Hooks", Hangers, and Velcro tie-wraps are all acceptable ways to support cable. However, installation of these supports must be done with care so as not to cause crushing or distortion of the cable, nor cause tighter bends than the minimum radius permitted for each type cable.
 - 1. See each specific Section requirements that shall be applied to this project in addition to these requirements.

- F. Allowable Cable Bend Radius and Pull Tension: In general, all cables cannot tolerate sharp bends or excessive pull tension during installation. The minimum radius bend shall be ten (10) times the cable outer diameter with no tensile load applied, and twenty (20) times the cable outer diameter with a maximum tensile load of 25ft/lbs applied during installation. The Contractor is responsible for maintaining the cable manufacturers Bend Radius and Pull Tension at all times. Corrections to cable installation shall be made to the satisfaction of the Engineer at no additional cost to the Port.
- G. Service Loops and Cable Management:
1. Comb all wires for the duration of the cable run so they are neat, orderly, do not have excessive slack, and are not tangled, prior to any service loop, continuing through any service loop, continuing into EACH Enclosure(s) and/or System Rack(s).
 - a. Provide a 10'-0" service loop of EACH device cable (a minimum of 2'-0" above the accessible ceiling (within 5'-0" of plan view) above EACH device.
 - b. For ceilings that are open to structure, do NOT provide a service loops, except for the following locations;
 - 1) MDF Rooms.
 - 2) IDF Rooms.
 - 3) Electrical Rooms.
 - 4) Storage Rooms.
 - 5) Designated system equipment locations that are NOT in view of the public.
 - 6) Prior to rough-in, obtain Engineer's approval.
 2. Cable Management shall be used to bundle all cables of like kind, separated by system type.
 3. See Systems Plywood Backboard Cabling, listed elsewhere in this specification for more information.
- H. The Contractor shall insure that communications cable is installed with care, using techniques which prevent kinking, sharp bends, scraping, cutting, deforming the jacket, or other damage. During inspection, evidence of such damage will result in the material being declared unacceptable. The Contractor shall replace all unacceptable cabling at no additional expense to the Port.
- I. The Contractor shall order and install the exact cables as specified on the Contractor's Shop Drawings. If at any time during the installation and through the warranty period, it is discovered that any cable other than what is called for on the Contractor's drawings has been installed, the Contractor shall remove all effected cables and shall provide and install the correct cable, as required. The Contractor shall also provide the staff to monitor the building during the cable replacement period until the System is fully operational to the satisfaction of the Engineer, without any additional cost to the Port.
- J. All horizontal cables shall be supported at a maximum of 4'-0" intervals with UL approved devices. At no point shall cables rest on, be tied to or otherwise secured to electrical conduit, plumbing, ventilation ductwork, accessible ceiling and/or light fixture hangers, or any other equipment. Cable shall be secured to building supports or wire hangers (at the structures ceiling) specifically designed to support cables and/or to additional blocks or anchors specifically installed for this purpose.

- K. All open cabling and/or conduit shall be installed parallel or perpendicular to the structure. Open cable installations shall use insulated mounting supports or rings approved for such use. Wiring shall be installed near or on structural members as to minimize risk of physical damage by other trades or maintenance personnel servicing the equipment.
- L. Installing open cabling and/or conduit on an exposed area of wall that could have been installed in a less conspicuous manner, especially where art or murals are to be painted is NOT acceptable. Any installation that does not meet this requirement will be required to be removed, and to patch and paint to match adjacent surfaces to the satisfaction of the Engineer. Then install the conduit, fasteners, and wire as required by the project, at no additional cost to the Port in an acceptable manner that meets with the Engineer's approval. Obtain direction from the Engineer prior to rough-in, for areas that need clarification.
1. In some cases, it may be more aesthetically appealing to install conduit down the wall to the floor and either through the floor or along the floor, to be less conspicuous. Contact the Engineer for further clarification.
- M. Conduit type and areas where conduit will be required for this project are:
1. Provide EMT metal raceway in the following areas:
- a. Always conceal conduits within walls and/or ceiling spaces wherever possible.
 - b. Where required by code. Provide conduit in all areas required by Code, but no less than the following locations.
 - c. To Accessible ceiling spaces. Provide conduit from the device to accessible ceiling space where:
 - 1) Devices are wall mounted.
 - 2) Are located on hard lid ceiling.
 - 3) In an inaccessible area. An inaccessible area is defined as less than 2'-0" from an accessible ceiling tile.
 - d. Unoccupied areas exposed to view. Unoccupied areas are defined as places that staff or the public will be in the room or area for only a few minutes, with the exception of service/maintenance personnel.
 - 1) This includes, but is not limited to:
 - (a) Mechanical rooms
 - (b) Electrical rooms
 - (c) Storage rooms
 - (d) Utility Room
 - (e) Janitorial Closet
 - (f) Other unoccupied rooms
 - 2) Install conduits to an accessible ceiling space, as defined above.
 - 3) Consult with the Engineer for further clarification.
2. Provide conduit, junction boxes, couplers, connectors, cabling and terminations as recommended by the manufacturer and as required by code.

3. Fill Requirements: Conduit, conduit sleeves, raceways, floor boxes, device boxes, mud rings, etc., shall be furnished and installed per the Division 26 requirements. Maintain all Conduit Code Fill Requirements, and provide no less than an additional 40% spare capacity for future growth.
 4. Conduit and Raceway Usage: All communications cable shall be dedicated for communications purposes, and not to be shared with other electrical wiring when required by code. Obtain written approval from EACH of the manufacturers if more than one system type is going to be installed in a single conduit.
 - a. Fire Alarm Cabling shall be in a separate, dedicated raceway (where indicated on the drawings).
 5. Pull Cords: Provide Nylon type pull cords in EACH Conduit raceway.
 6. Provide surface mounted raceway in the following areas (For Retrofit/Remodels or as directed by the drawings or Engineer):
 - a. Occupied areas exposed to view. Occupied rooms. Generally, occupied areas are defined as places that staff or the public will be in the room or area for more than a few minutes.
 - 1) This includes, but is not limited to:
 - (a) Administrative areas.
 - (b) Office space(s).
 - (c) Other occupied rooms.
 - b. Install conduits to an accessible ceiling space, as defined above.
 - c. Size conduit(s) as required.
 - d. Consult with the Engineer for further clarification.
 7. Surface mounted conduits of any kind may only be installed after every attempt has been made to conceal wiring and/or conduits specified within this document. Obtain prior approval from the Engineer, before installing surface-mount conduit.
 8. Prior to installation, contact the Engineer if these instructions are not clear, or field conditions require further clarification of the intent of the installation.
- N. Cable Lubricants: Lubrications specifically designed for installing cables may be used to reduce pulling tension as necessary when pulling cable into conduit. After installation, exposed cable and other surfaces must be cleaned of lubricant residue.
1. Recommended Products:
 - a. Dyna-Blue.
 - b. American Polywater.
- O. Horizontal Cabling:
1. Horizontal cable terminations shall be made at the appropriate patch panel and labeled as noted on the Outlet Schedule. At each outlet box, a sufficient length of spare cable shall be provided for terminating outlet devices such that the outlet can be easily removed and inspected. In addition, each cable shall be terminated as indicated below:

- a. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-C document, manufacturer's recommendations and/or best industry practices.
 - b. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
 - c. The cable jacket shall be maintained as close as possible to the termination point.
- P. Systems Plywood Backboard Cabling:
1. Cable shall be routed as close as possible to the ceiling, floor, or corners to insure that adequate backboard space is available for current and future equipment and for cable terminations. Cables shall NOT be tie-wrapped to existing electrical conduit, existing cables, or other equipment. Minimum bend radius shall be observed.
 2. Install cables via the shortest route directly to the nearest edge of the backboard from the mounted equipment or block. Lace, Plastic or Velcro tie wrap all similarly routed cables together, and attach to the outside edge(s) of the backboard vertically and/or horizontally, then route via "square" corners over a path that will offer minimum obstruction to future installations of equipment and/or other cables.
 3. See "Service Loops and Cable Management" listed within this specification for additional information.

3.04 SYSTEMS PLYWOOD BACK BOARD(S)

- A. Systems plywood back board(s) shall be used to mount enclosures of any kind, to any wall or surface. The systems plywood backboard shall be securely fastened to the walls to accommodate no less than ten times the total weight of the equipment to be mounted. The systems plywood backboard shall be a minimum of 3/4", APA exterior grade Douglas Fir A-C, and fire retardant with a flame spread rating not more than 25 when tested according to ASTM E-84. Provide the systems plywood backboard from the floor up to ceiling height (not exceeding 12'-0") on all walls shown, unless otherwise noted. The entire backboard shall be painted with three (3) coats of fire retardant paint (the color shall match the adjacent surface). EACH enclosure, when mounted, shall bear a minimum of 150 pounds weight on the enclosure.
- B. Mounting of equipment shall be logically placed, and shall be located at the top, bottom, left, or right portion of the systems plywood backboards to accommodate future growth of the system. Under no circumstances will the equipment be allowed to be mounted in the middle of the backboards.

3.05 GROUNDING

- A. Ground all equipment per the Manufacturers recommendations, per Division 26 and as required by Code.
- B. Provide grounding and bonding per ANSI-STD-J-607-A.
- C. Provide (1) #3/0 green insulated copper grounding conductor in 1" conduit from the Main Electrical Room MDB Ground Busbar to the Main Distribution Frame (MDF) Telecommunication Main Grounding Busbar (TMGB).
- D. Provide (1) #3/0 green insulated copper grounding conductor in 1" conduit between the MDF Room TMGB and EACH designated Intermediate Distribution Frame (IDF) location shown on the drawings and terminate on the Telecommunication Grounding Busbar (TGB).

- E. Provide (1) #3/0 green insulated copper grounding conductor in 1" conduit between the EACH designated Intermediate Distribution Frame (IDF) location shown on the drawings and terminate on the Telecommunication Grounding Busbar (TGB).
- F. See Section 27 20 00.01 "TMGB (Telecommunication Main Grounding Busbars)" for additional Grounding requirements.

3.06 DEVICE RELOCATIONS

- A. Device location may be changed prior to installation, within 15'-0" without extra charge, if so desired by the Engineer.

3.07 INSTALLATION

- A. Provide all equipment, wiring, conduit, and outlet boxes required for the installation of a complete, fully functioning, operating system in accordance with applicable local, state, national codes, AHJ requirements, 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.
 - 1. Color coded wires shall be used throughout.
 - 2. Wiring shall conform to the National Electrical Code Article 725.
- B. Provide 120vac wiring and connections to the Control Panel(s), EACH Amplifier(s), CPU(s), DVR(s), and Power Supply(s) as required for a fully functional system, while maintaining all of the design requirements described elsewhere within each system specifications. At a minimum, this shall include the following;
 - 1. Multiple Power Supplies and/or the Control Panel(s) may be placed on the same circuit, while maintaining all code mandated load calculations, but shall be on circuit(s) that is dedicated for EACH System.
 - a. Consult with the Engineer to verify load calculations meet all code requirements.
 - b. Install 120 VAC wiring and conduit as specified in Division 26.
 - c. Show on the As-Built drawings, the location of each panel board that is being used to power any System equipment, and, at the panelboard, list each panelboard circuit for each system (i.e. Panelboard "x", circuit 12=FAPS-3; Circuit 14=IACP).
- C. Maintain all fire wall ratings, as required.
- D. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate subcontractors.
- E. EACH manufacturer's authorized representative shall provide on-site supervision of the installation for EACH of the systems equipment for the duration of the project. This includes programming, training, and the Port's ability to use the Complete System Functionality as it was designed.
- F. Install wire guards at locations as shown on the drawings and as described elsewhere within these specifications.
- G. Every attempt shall be made to avoid running telecommunications close to (less than 2'-0") and/or parallel to other communication cables in the building, all lighting, and conduits containing 120vac (or greater). This shall be to avoid interference with any other service or system, operation, or maintenance purposes such as access boxes, ventilation-mixing boxes, access hatches to air filters, switch or electrical outlets, electrical panels, fire alarm equipment, clock systems, and lighting fixtures. Avoid crossing areas horizontally just above or below any

conduit and/or riser. Route cables in such a manner to allow other cables to enter the conduit and/or riser without difficulty at a later time by maintaining maximum distance from these openings. Maintain all recommended distances from other cables, as required by the manufacturer. Install cable to whichever of these two requirements are more stringent.

- H. Room numbers shown on plans are architectural designs numbers for construction purposes. These numbers are NOT to be used for programming. Final system programming shall reflect the final room numbering plan and actual room signage, unless directed to otherwise in writing or as specified in another specification section. Update the As-Built Drawings to reflect the final room numbering plan and actual room signage.

3.08 MOUNTING HEIGHTS, LOCATIONS, AND SETTINGS

- A. Install all equipment as recommended by the Manufacturer.
- B. The installation of EACH device, enclosure, and/or control panel shall be installed so that the Port will be able to access, test and/or replace any component of the system. If this installation does not meet this requirement to the satisfaction of the Engineer, it will not be accepted. The Contractor shall be required to remove the item, patch and paint the area to the satisfaction of the Engineer, and reinstall the device, enclosure, or control panel as required to make the system easily maintainable and acceptable, at no additional cost to the Port.
- C. Control Panel(s), Power Supply(s), and Locations:
 - 1. Mount Control Panel(s), Power Supplies, and Enclosures (provide quantities as required) with approximately two inches of separation between the enclosures.
 - 2. Each enclosure, when mounted, shall meet the following criteria;
 - a. Conduit shall not enter any enclosure or panel, except where conduit entry is approved by the manufacturer.
 - b. Chase nipple the enclosures together. At a minimum, use two (2) 1½" conduits. Size and/or provide additional conduits as required. Provide conduits between enclosures to accommodate an additional 100% conduit fill while maintaining all NEC requirements. Avoid installing chase nipples where batteries are to be installed (contact the manufacturer and/or the Contractor prior to drilling any holes). Any chase nipples installed where batteries are to be located will be rejected, and require the reinstallation as specified, up to and including installing new enclosures.
 - c. The bottom of the chase nipples shall be a minimum of two-inches above the location where any batteries are to be installed.
 - d. EACH enclosure door shall be able to open no less than 105°.
 - e. The top of each enclosure shall be mounted at the same height of 60-inches above the finished floor and shall be level.
 - f. If changes to the above requirements are preferred, contact the Engineer for approval prior to rough-in.
- D. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (IE: devices shall not be supported solely by suspended ceilings). Fasteners and supports shall be able to support the no less than four times the weight of the equipment and/or device.
- E. Rack Equipment: EACH Rack shall be securely attached to the floor and/or wall using the manufacturer's recommended mounting hardware.
- F. See each system specification for additional mounting information.

3.09 FLUSH MOUNT AND SURFACE MOUNT EQUIPMENT AND ENCLOSURE LOCATIONS

- A. Prior to rough-in, consult the Engineer for clarification for Flush Mount and Surface Mount locations.
- B. Flush mounted equipment and enclosures shall be installed in areas where the rooms are finished such as Administrative Areas, Offices, Work Rooms, Break Room and Corridors. Provide the appropriate finish work around each enclosure as required. This type of equipment includes, but is not limited to the following:
 - 1. Enclosures: Typically are Control Panels, Power Supplies, etc.
 - a. Provide the manufacturers flush mount Trim Rings, Adapters, and/or Brackets for this type of equipment.
- C. Surface mounted equipment and enclosure shall be installed in areas where the rooms are NOT finished such as Electrical Rooms, MDF/IDF Rooms, Mechanical Rooms, or Utility Rooms. Unless otherwise noted, this equipment shall be installed on the Systems Plywood Back Boards. This type of equipment includes, but is not limited to the following:
 - 1. Enclosures: Typically are Control Panels, Power Supplies, etc.
 - 2. Punch Blocks: Typically are used with Telephone PBX and Intercom equipment.
 - 3. Wall Mounted and Floor Mounted Racks.

3.10 NUMBERING AND LABELING

- A. Phenolic Plates:
 - 1. Install phenolic plates at each of the Control Panel(s), Power Supply(s), Terminal Cabinet(s), and Rack(s).
 - a. All phenolic plates shall be secured to each enclosure with rivets.
 - b. Install each plate 1" from the top of the enclosure, and be centered on the door. Relocate as required to avoid interfering with equipment or components within the enclosure or that may prevent the enclosure door from closing properly. The location of the phenolic plates shall be consistently installed in the same location on each system enclosure, at EACH location.
- B. Terminal Cabinets:
 - 1. Label each termination point on the inside of EACH enclosure door. All information shall be legible, as defined by the Engineer.
- C. Addressable Devices/Address Point Labels (where applicable):
 - 1. Install the Address Label for each addressable device on or near the device. Verify with the Engineer.
 - 2. Clean the surface from dust, grease, or lubricants as recommended by the manufacturer of the label.
 - 3. The addressable label shall be able to be viewed by the general public when standing on the ground.
 - a. Prior to Installation, coordinate with the Port Representative for exact location of how and/or where to mount the address label for EACH device type to fulfill this requirement, prior to installation.
 - 4. Provide the following address label format:

- a. The background shall be clear (see through).
- b. The text shall be Black in color, and a minimum of ½" tall.
- c. Use Brothers or P-Touch models to produce the label.

3.11 WIRING

- A. For consistency of wiring throughout the entire system equipment, if specific conductor colors are not called out in EACH system specification, then the following colors shall apply:
 1. Red is (+) Positive voltage or data bus (+) positive.
 2. Black is (-) Negative voltage or data bus (-) negative.
 3. White is common.
 4. Green is normally open or normally closed.
- B. Wiring within EACH enclosure shall have the outer jacket of the cable removed to within three-inches of the cable entering the enclosure. Individual conductors from each jacketed cable shall be spirally twisted to keep them together, until they are routed into each appropriate individual terminal. Route all conductors parallel with the walls of the enclosure, make 90° turns within the enclosure, and always keep a two-inch minimum spacing from any circuit board and/or terminals.
 1. Labeling of Cables.
 - a. Prior to installing any label, clean each cable with the appropriate cleaner to remove any pulling compound residue, grease, oil, dirt, etc. in order for the label to properly adhere to the cable jacket.
 - b. The Label shall indicate the Device or Outlet and the area or wing of the building that the cable is being routed from. The Label shall also indicate the MDF Room or designated IDF location that the cable is being routed to.
 - c. Each label shall be located on each cable that enters any enclosure or junction box, and shall be easily visible and readable.
 - d. The cable numbering system shall be consistent with shop drawings.
- C. End-of-Line (EOL) Resistors: Each device that is capable of being supervised by the Control Panel and/or Power Supply shall be supervised. Install equipment and/or program as required.
 1. Indicate on the As-Built drawings where EACH of the End-Of-Line Resistors is located.
 2. Each End-of-Line Resistor shall be installed at the last device on each circuit. Locating the EOL in the Control Panel and/or Power Supply is NOT acceptable.
- D. The telephone dialer connections and Ethernet WAN connections shall be made by the Contractor. Coordinate with the Engineer for scheduling the Port's IT Department to supervise all terminations and connections.
- E. All wiring routed under slab or underground shall be suitable for wet locations.
- F. The Contractor shall clean all dirt and debris from the inside and the outside of EACH enclosure after completion of the installation, and prior to any testing being performed.
- G. All circuits shall be identified in accordance with table below and all labels shall include wire type, quantity and circuit number. Wire code shall match approved shop drawings wire code.

Table

Example: C2HX3

C = Signal Circuit Wire

2 = Signal circuit number

H = LCD Keypad wire

X = Addressable initiating device circuit wire

3 = Addressable initiating device circuit number

3.12 SPLICE CONNECTORS AND CONNECTIONS

- A. All references to splices are for cables that are 50 volts or less.
- B. A continuous cable run without any splices is the preferred method. When a splice is required the following information shall apply.
 - 1. Cable splices are only allowed in accessible, dry locations, in a junction box or terminal cabinet suitable for the purpose. The only exception is for field devices that have wire leads (i.e. Pigtail) and require a connection of two wires at the device.
 - a. Each cable end that is spliced must be labeled, as specified. (i.e.: At the splice point, "From FACP in MDF Room XXX" on one cable, and "To the East Wing RCAP" on the other cable).
- C. All splices shall be performed in one of the following methods:
 - 1. Wire nuts shall NOT be used on this installation, will be deemed unacceptable, and shall be removed and installed as outlined below.
 - 2. In Junction Boxes:
 - a. Either one of the following Splice Methods are acceptable:
 - 1) Use the Tool-less Terminal Strip, Model Number SSU00470 (Black) or SSU00471 (White), and SSU00465 (the Back Box Bracket) for use with extra deep 4S boxes. This equipment is manufactured by Space Age Electronics.
 - 2) Use Model DC-100-S Blue Dolphin Connectors (with Sealant), Manufactured by Dolphin Components Corporation, on all splice connections that are size 18 gauge or less. The rubber coated outer jacket of the inch-long connector shall contain non-curing sealant that fills the crimp cavity when crimped. Strip the color coded outer jacket of each individual conductor that is going to be crimped, approximately 1/8-inch shorter than the length of the crimp connector, so that when the conductors are inserted all of the way in the connector, no bare wires (or any strands of wire) are exposed or visible out of the connector.
 - 3. In Terminal Cabinets:
 - a. In Terminal Cabinet(s) with each conductor to be landed on a separate terminal.
 - b. Indicate on the Shop Drawings and As-Builts, the locations of EACH Terminal Cabinet.
 - c. Maintain the "Spare Capacity" requirements, as specified.
 - 4. At Field Devices (where the device has wire leads and not a terminal strip).
 - a. Use Model DC-100-S Blue Dolphin Connectors as described above.
 - 5. Spare or unused conductors shall be:

- a. Landed on terminal strips.
- b. Shall have the Blue Dolphin Connectors crimped on the end of each conductor.
 - 1) Field devices with pigtails shall have a Blue Dolphin Connectors crimped on the end of any unused conductor(s).
- D. All conductors, if spliced, shall be ONLY spliced to the same gauge size and color of conductor. Changing of gauge size or color at any point within any cable run is strictly prohibited, and all cables will be replaced at no additional cost to the Port, and to the satisfaction of the Engineer.
 - 1. If the field device has wire leads, then wire as necessary at the device for proper operation. Indicate the color code change on the shop drawings per point wiring diagrams. Update any and all changes to the drawings, for accurate as-builts.

3.13 ON-SITE SYSTEM INFORMATION BINDER ENCLOSURE

- A. The Contractor shall install the wall mount enclosure that is labeled "(Section Title here) information". The enclosure shall be located in the administrative area or the MDF room. Verify the exact location with the Engineer, prior to installation.
- B. The enclosure shall have a Site specific manual, in a "D" style 3-ring binder with an 18-inch heavy-duty chain securely fastened to the inside of the enclosure.
- C. See "As-Built Documentation" for more information.

3.14 TESTING & COMPLETE SYSTEM FUNCTIONALITY (SPECIFICALLY FOR THE FIRE ALARM SYSTEM ONLY)

- A. The Contractor shall notify the Engineer a minimum of five (5) business days in advance of testing.
- B. The warranty shall NOT begin until the following conditions have been met:
 - 1. Fire Alarm System Testing:
 - a. The Contractor shall provide two-way communication devices for their own staff and Engineer so that all parties can communicate as required to perform all tests.
 - b. Completely fill out the 2007 Edition NFPA Fire Alarm System Record of Completion document.
 - c. Obtain the AHJ signature, printed name, date, and telephone number on the Record of Completion.
 - d. Obtain the AHJ signature, printed name, date, and telephone number on the Fire Alarm Permit.
 - e. If the Contractor fails the Fire Marshal Inspection, the following shall occur;
 - 1) The Contractor shall make all of the necessary corrections as required, to pass the AHJ testing and inspection. Then, notify the AHJ and schedule another test, and continue making corrections until the Fire Alarm System has been accepted by the AHJ.
 - f. The Contractor is subject to the Close Out requirements as specified in Schedule of Values.
 - 2. Training:
 - a. Refer to Section 28 31 00.01 for the Training Requirements as described in "Training Materials".

3. Complete System Functionality:

- a. After ALL the above conditions have been met, and includes each of the required signatures, this shall then be deemed that the Port's ability to use the Complete System Functionality as it was designed.
- C. Upon completion of the installation, testing, and Instruction & Training, the Contractor shall provide the following Signed Test Forms, in the as-built documentation as required.
1. The signed original Record of Completion
 2. The signed original Fire Alarm Permit

3.15 TESTING & COMPLETE SYSTEM FUNCTIONALITY (FOR ALL SYSTEMS THAT IDENTIFY THIS TESTING REQUIREMENT)

- A. The warranty shall NOT begin until the following conditions have been met:
1. Obtain the AHJ signature, printed name, date, and telephone number on the Permit(s) and other required documentation. Provide this documentation with the As-Built documents.
 2. The Contractor shall provide a copy of the (Section Number and Section Title here) - Operational Test Form has been performed and submitted to the Engineer for review. The purpose of this document is to show that the Contractor has in fact performed a complete test. In some cases, every device may not pass the test. This shall serve as the Contractor own punch list, to make corrections prior to the Acceptance Test. This must be completely filled out, and have an original signature of the representative of the Contractor. Allow for a minimum of ten (10) business days for the Engineer to review this document.
 3. After the Engineer's review of the System Operational Test Form, the Engineer will discuss the results of the test with the Contractor.
 4. The Contractor shall coordinate with the Engineer to witness Performance Test. Allow for a minimum of ten (10) business days to schedule this testing.
 5. System Testing:
 - a. The Contractor shall provide two-way communication devices for their own staff, each Port's Representative, and the Engineer, so that all parties can communicate as required to perform all tests.
 - b. The Contractor shall demonstrate the testing of each device, to the Port's Representative and the Engineer, and document this information on the (Section Number and Section Title here) - Performance Test Form.
 - c. Upon the completion and passing the Performance Test with 100% positive results, the Acceptance Test form shall be signed by the Contractor and the Engineer.
 - 1) If the Contractor fails this test by NOT passing the test with 100% positive results, the following shall occur;
 - 2) The Contractor shall make all of the necessary corrections to provide 100% positive results.
 - 3) The Contractor shall document the corrective action taken for each item that failed the Test, and submit to the Engineer for review. Upon approval by the Engineer, the Acceptance Test shall be rescheduled.

- 4) The Contractor is subject to the Close Out requirements as specified in Section 20 00 00.01, Schedule of Values.
6. Training:
 - a. Refer to EACH specific Section for the Training Requirements as described in "Training Materials and Programming Survey".
7. Complete System Functionality:
 - a. After ALL the above conditions have been met as deemed by a "Pass" on the Governing Acceptance Form - (Section Name and Section Title here), all training has been completed, and the required signatures have been acquired, this shall then be deemed that the Port's ability to use the Complete System Functionality as it was designed.

3.16 WARRANTY

- A. The Contractor shall include in the pricing of their bid that they will honor and provide EACH of the manufacturers Full Term Warranty period for the provision of replacement equipment for EACH individual device and/or component provided for this project. The completed and fully functional System, including wiring, installation, and all equipment shall be free from inherent mechanical and electrical defects. At a minimum, this shall be no less than one (1) year from the date of Complete System Functionality as defined in "Testing & Complete System Functionality" portion of this specification. Warranty service for the on-site replacement of equipment shall be provided by the system supplier's Manufacturer trained representative during normal working hours, Monday through Friday, excluding holidays, and respond for service no later than the following business day after the call was received.
- B. When the manufacturers warranty exceeds one year, the Contractor shall be responsible for replacing the actual component or device for the Full Duration of the manufacturer's warranty, if the Port or their representative chooses to take the item to the Contractor place of business. If the Port chooses to have the Contractor provide on-site service, then the Contractor is entitled to their standard published (or negotiated) labor rates and miscellaneous material items to replace the damaged warranty item.
- C. The Contractor who is authorized to provide Warranty Service for this project is defined in "Quality Assurance" located in Part 1 of this specification.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SCOPE

- A. The installation shall include innerduct, fire rated penetration assemblies, conduit, cable tray, and wire management
- B. The bonding of metallic raceways
- C. The work performed under this specification shall be of good quality and performed in a workmanlike manner. In this context "good quality" means the work shall meet industry technical standards and quality of appearance.
- D. The system shall meet ALL of the requirements listed in Section 27 00 00.01 Low Voltage Systems General Requirements PART 3 "Testing & Complete System Functionality", prior to "Substantial Completion".
- E. Contractual information, guidelines, requirements, or other work specified to provide a fully functional system for Section 27 05 28.01 includes, but is not limited to the sections identified in Section 27 00 00.01.

1.03 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to work specified in this Section.
- B. Applicable Standards: All work shall be performed in accordance with the latest revisions of the following standards:
 - 1. National Electrical Manufacturers Association:
 - a. NEMA FG 1 - Fiberglass Cable Tray Systems.
 - b. NEMA VE 1 - Metal Cable Tray Systems.
 - c. NEMA VE 2 - Cable Tray Installation Guidelines.
 - 2. NFPA 70: National Electrical Code
 - 3. ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises
 - 4. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 - 5. ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. Work in this section shall be performed by a licensed and bonded low voltage Contractor with a minimum of five years' experience in the installation and maintenance of high speed data and voice networks. Only Contractors whose primary business is that of installing, maintaining, troubleshooting, and testing Telecommunication Infrastructures shall perform this work.

2. License Classification: Contractor must possess a valid Washington State 06 Electrical Low Voltage License.

1.05 GOVERNING CODES AND CONFLICTS

- A. If the requirements of this section or 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 or the Drawings shall be construed to permit work not conforming to all governing codes and regulations.

1.06 PROJECT CONDITIONS - ARCHITECTURAL PLANS

- A. The Contractor shall carefully coordinate the various symbols utilized on the drawings and shall consult the architectural plans to determine ceiling and floor types in the various areas.

1.07 SUBMITTALS

- A. Seismic Bracing
- B. Open Cabling Support and Hardware
- C. Cable Tray – Ladder Style
- D. Fire Rated Penetrations

PART 2 - PRODUCTS

2.01 MATERIALS

- A. See Section 27 00 00.01 Low Voltage Systems General Requirements for additional requirements.
- B. The Contractor shall review the Site Plans, Floor Plans, Riser Diagrams, and Detail Sheets for additional work that is required to be performed by the Contractor of this section.

2.02 SEISMIC BRACING

- A. Provide Seismic Bracing as required by the AHJ.
- B. This includes, but is not limited to:
 1. Racks.
 2. Cable Tray.
 3. Cable Supports.

2.03 OPEN CABLING SUPPORT & HARDWARE

- A. Each Cable Support shall be UL Listed for the Application and meet the TIA requirements for structured cabling systems.
- B. Provide manufacturer approved mounting brackets and fasteners.
- C. Do not exceed the cable support manufacturer's cable fill capacity for each type provided for this project.
- D. Do not exceed the cable manufacturer's recommendations for cable suspension in open cabling environments.
- E. J-Hooks shall have a galvanized finish.
 1. Manufactured by Erico CADDY: Model # CAT32HP, or approved equal. Provide quantities as required.

2. Manufactured by Erico CADDY: Model # CAT48HP, or approved equal. Provide quantities as required.
- F. Mounting Tree:
 1. Manufactured by Erico CADDY: Model # CATHPTM, or approved equal. Provide quantities as required.
- G. Adjustable Cable Support:
 1. Manufactured by Erico CADDY: Model # CAT425 Series, or approved equal. Provide quantities as required.
- H. Conduit Waterfalls:
 1. Conduit Waterfalls shall be used where conduits empty into cable trays.
 2. Manufactured by Panduit: Model # CWF400, or approved equal. Provide quantities as required.
- I. Conduit Bushings:
 1. Conduit Bushings shall be used to protect communications cabling where conduits terminate in accessible ceiling space.
 2. Bushings shall be non-metallic to reduce cable abrasion.
 3. Manufactured by Arlington: Model #EMTXXX, or approved equal. Provide quantities as required.

2.04 CABLE TRAY – LADDER STYLE

- A. Chatsworth Products (CPI) is the basis of design for all ladder-style cable. Equivalent manufacture's solutions may be submitted for prior approval no less than 2 weeks before bid date closing. Products not submitted for prior approval shall be rejected.
- B. Provide Seismic bracing where required by the AHJ.
- C. The Cable Tray shall be UL Classified.
- D. The Cable Tray shall be 1.5" high x 18" wide (unless otherwise noted) with 9" rung spacing in Steel construction that has been painted by the manufacturer.
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 11275-718, or approved equal. Provide quantities as required.
- E. Butt Splice, Junction Splice, Swivel Butt Splice, Swivel Junction Splice, Wall Mount Bracket, Rack Mount Plate, Ground Strap, Cable Runway Dividers and Cable Radius Drop:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 16301-701, or approved equal. Provide quantities as required.
- F. Junction Splice:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 16302-701, or approved equal. Provide quantities as required.
- G. Swivel Butt Splice:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 16487-701, or approved equal. Provide quantities as required, where applicable.
- H. Swivel Junction Splice:

1. Manufactured by Chatsworth Products Inc (CPI): Model # 16488-701, or approved equal. Provide quantities as required, where applicable.
- I. Wall Mount Bracket:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 11746-718, or approved equal. Provide quantities as required.
- J. Ground Strap:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 40164-001, or approved equal. Provide quantities as required.
- K. Cable Runway Dividers:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 13392-721, or approved equal. Provide quantities as required.
- L. Cable Radius Drop:
 1. Manufactured by Chatsworth Products Inc (CPI): Model # 12100-718, or approved equal. Provide quantities as required.
 2. Manufactured by Chatsworth Products Inc (CPI): Model # 12101-702, or approved equal. Provide quantities as required.

2.05 FIRE RATED PENETRATIONS

- A. Provide Fire Rated Penetration equipment for EACH wall that is rated for 1-Hour or more.
- B. A firestop system shall be comprised of the item or items penetrating the fire rated structure; the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Firestop systems comprise of an effective block for fire, heat, vapor, and pressurized water stream.
- C. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly firestopped.
- D. Firestop systems shall be UL Classified to ASTM E814 (UL 1479).
- E. Indicate on the Shop Drawings EACH location showing the proposed firestopped system location for approval, prior to installing the firestop system(s).
- F. All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local authorities prior to cabling system acceptance.
- G. For EACH penetration, the following requirements shall apply:
 1. Provide pathway assemblies for EACH Low Voltage System Cables for each individual assembly opening.
 2. Provide the quantity of pathway assemblies required for the Horizontal cables, while maintaining all code requirements. Additionally, provide (1) pathway assembly opening for EACH System listed on the Electrical Legend. This includes, but is not limited to: Fire Alarm System, CCTV System, etc.) and no less than (2) Spare empty assembly openings, which shall remain empty at the completion of the project.

3. Manufactured by Specified Technologies, Inc (STI): EZ Path Model # 33 Series and/or EZ Path Model # 44 Series. Provide quantities as required for all rated installations.
 - a. For EACH penetration, provide the Stud Wall Attachment (for either series provided), filling the entire stud wall space with cable pathways for all cabling required and future cabling. Maintain all spare capacity requirements.
 - b. For EACH EZ Path Model # 33 Series provided, provide one pair of Radius Control Modules.
 - c. Manufactured by Specified Technologies, Inc (STI): EZ Path Model # RCM33.
4. Manufactured by Specified Technologies, Inc. (STI): EZ Path Model # NEZP33 Series. Provide quantities as required for all non-rated installations.

PART 3 - EXECUTION

3.01 GENERAL

- A. See Section 27 00 00.01 Low Voltage Systems General Requirements for additional information.
- B. Prior to rough-in, coordinate with the Engineer for the exact location(s).
- C. Install all equipment per the manufacturer's recommendation.

3.02 PRODUCT INSPECTIONS

- A. The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of proper gauge, containing correct number of pairs, and is the material ordered. Any physical damage to the cable and wire must be noted; un-uniform jacket thickness and jacket tightness should also be identified. Note any buckling of the jacket, which would indicate possible problems.

3.03 GROUNDING AND BONDING

- A. Provide grounding and bonding per ANSI-STD-J-607-A, which includes, but is not limited to: Cable Tray, Rack(s), conduit sleeves, and other equipment connected to the TMGB/TGB.
- B. The minimum conductor size shall be #6 green insulated copper grounding conductor. However, size each conductor shall be based on the actual cable length as defined in ANSI-STD-J-607-A.

3.04 HORIZONTAL PATHWAYS

- A. It is the responsibility of the contractor to ensure that ALL PATHWAYS for the permanent link of each balanced twisted pair cable shall not exceed 295' in length from work area outlet to telecommunications room patch panel.
- B. To ensure this length, all pathways shall be coordinated and installed prior to pouring of any slabs or the installation of any permanent structure which would inhibit a conduit or cable tray run from being installed after the structure is complete.
- C. See section 27 20 00.01 for horizontal cabling types and additional requirements.

3.05 FIRE RATED PENETRATIONS

- A. Install per manufacturers recommendations.
- B. Maintain all Code and AHJ requirements.

3.06 PLENUMS

- A. Provide metallic conduit through building plenum spaces for all cables which do not bear a CMP rated label.

3.07 WARRANTY

- A. The warranty shall be direct to the end user, from the manufacturer, supported through the installing and Contractor, and shall cover both materials and labor costs for any claims related to the warranty program.

3.08 OPERATION & MAINTENANCE MANUALS (O&M'S)

- A. Provide all Operation & Maintenance Manuals (O&M's) documentation as defined in Section 27 00 00.01 Low Voltage Systems General Requirements and listed elsewhere in this specification.

3.09 AS-BUILT DRAWINGS

- A. Provide all As-Built documentation as defined in Section 27 00 00.01 Low Voltage Systems General Requirements and listed elsewhere in this specification.
- B. All labeling shall match the final room number identification at completion of the project (not the room number that is indicated on the Bid Set of drawings).
- C. Update all documents provided in the Submittal and Shop Drawings to accurately reflect the actual equipment that was provided for this project, and the actual locations of the installed equipment.
- D. The Contractor shall provide As-Built drawings to the Engineer, which clearly indicates:
 - 1. The floor plan of the building showing the As-Built location of conduit runs, cable tray, and terminal cabinets.

3.10 DEMONSTRATION AND TRAINING

- A. Upon completion of the system installation, the installation representative shall conduct a system test for the Port staff.
- B. Upon completion of the installation, after test and demonstration, the Contractor shall provide to the Engineer a signed written statement substantiating the:
 - 1. "System has been completely tested, demonstrated to the Engineer, and accepted by the appropriate authority."

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section.

1.02 SCOPE

- A. The Contractor shall furnish and install all materials for a complete, fully functional data and voice Telecommunications Infrastructure system in accordance with this specification and the contract drawings. The system shall be in full compliance with a "Limited Lifetime Warranty". The Contractor shall be responsible for providing a complete, functional system including all necessary components, whether included in this specification or not.
- B. The installation shall include Fiber Optic Cable and Copper Category Rated Cables, interconnect equipment, connectors, jumpers punch blocks, fiber optic patch panels, copper patch panels, patch cables, telecommunication outlets, wire management, and racks.
- C. The Contractor is required to coordinate with the Engineer so that the telephone system can be patched into the Data and Voice infrastructure by the Contractor.
- D. All copper Horizontal Cables shall be terminated on patch panels in the Telecommunication Rooms (MDF and designated IDF locations) and on Telecommunications Outlets. All copper backbone cables shall be terminated on punch blocks at main cross connects and on patch panels at the horizontal cross connect end, unless noted otherwise.
- E. Upon completion of installation, the Contractor shall test all fiber and copper cables. All cables shall be tested as defined elsewhere within this specification.
- F. The work performed under this specification shall be of good quality and performed in a workmanlike manner. In this context "good quality" means the work shall meet industry technical standards and quality of appearance. The Port reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- G. The system shall meet ALL of the requirements listed in Section 27 00 00.01 Low Voltage Systems General Requirements PART 3 "Testing & Complete System Functionality", prior to "Substantial Completion".
- H. Contractual information, guidelines, requirements, or other work specified to provide a fully functional system for Section 27 20 00.01 includes, but is not limited to the sections identified in Section 27 00 00.01.
- I. See "Horizontal Cable" and "Racks" located in this specification for additional work and equipment. This includes, but is not limited to; CAT6 Cabling for ALL Local Area Network (LAN) based Systems as shown on the plans, detail sheets, and riser diagrams.

1.03 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to work specified in this Section.
- B. Applicable Standards: All work shall be performed in accordance with the latest revisions of the following standards:
 - 1. BICSI Information Technology Systems Installation Methods Manual, 6th Edition
 - 2. BICSI Telecommunications Distribution Methods Manual, 13th Edition
 - 3. ANSI/TIA 606-A (2002) Administration Standard for Commercial Telecommunications Infrastructure.

4. ANSI/TIA 607-B Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. EIA/TIA-455-61 (latest edition). "FOTP-61, Measurement of Fiber or Cable Attenuation Using An OTDR".
6. TIA-526-7. Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant OFSTP-7.
7. ANSI/TIA 568-C.0. "Generic Telecommunications Cabling for Customer Premises."
8. ANSI/TIA 568-C.1. "Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements."
9. ANSI/TIA 568-C.2. "Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components."
10. ANSI/TIA 568-C.3. "Optical Fiber Cabling Components Standard."
11. EIA/TIA 569-B. "Commercial Building Standard for Telecommunications Pathways and Spaces."
12. IEEE 802.3 (latest edition) "Carrier Sense Multiple Access With Collision Detection."
13. International Building Code (latest edition).
14. International Fire Code (latest edition).
15. NEC (National Electrical Code) (latest edition).
16. Telecommunications Architectural Standards - In Washington State Government (latest edition).

1.04 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The Contractor project manager shall hold a valid and current Registered Communications Distribution Designer (RCDD) certification issued by Building Industry Consulting Service International (BICSI). The project manager shall have a minimum of five years' experience with projects of similar size and scope.
2. The Contractor field staff installers shall hold valid and current Installation certifications issued by Building Industry Consulting Service International (BICSI) or hold documented certification of training from the manufacturer of the cabling and equipment that is being installed. The field staff shall have a minimum of five years' experience with projects of similar size and scope.
3. The Contractor shall be an Authorized Partner of the Manufacturer of the equipment being installed and shall furnish documentation showing that the Contractor is trained and certified. The Contractor shall be capable of providing the Engineer with a documented 25 Year "Application Warranty" of the equipment being installed.
4. Work in this section shall be performed by a licensed and bonded low voltage Contractor with a minimum of five years' experience in the installation and maintenance of high speed data and voice networks. Only Contractors whose primary business is that of installing, maintaining, troubleshooting, and testing Telecommunication Infrastructures shall perform this work.
5. In order to qualify for installation of the Telecommunications Infrastructure Contractor must possess the required license classification, a performance history, experience in the

installation and termination of copper and optical fiber cable systems, and proof of time in business.

6. License Classification: Contractor must possess a valid Washington State 06 Electrical Low Voltage License.

1.05 GOVERNING CODES AND CONFLICTS

- A. If the requirements of this section or 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 or the Drawings shall be construed to permit work not conforming to all governing codes and regulations.

1.06 PROJECT CONDITIONS - ARCHITECTURAL PLANS

- A. The Contractor shall carefully coordinate the various symbols utilized on the drawings and shall consult the architectural plans to determine ceiling and floor types in the various areas.

1.07 SUBMITTAL REQUIREMENTS OF THIS SECTION

- A. Proof of contractor qualifications listed on paragraph 1.04.
- B. Seismic Bracing
- C. Labeling
- D. Telecommunication Outlets
- E. Fiber Optic Cable Termination Hardware
- F. Horizontal Cable – Inside Plant (ISP)
- G. Patch Panels – Copper
- H. Patch Cables – Copper
- I. Racks
- J. Cable Management Ties
- K. Telecommunication Main Grounding Bussbars

PART 2 - PRODUCTS

2.01 MATERIALS

- A. See Section 27 00 00.01 Low Voltage Systems General Requirements for additional requirements.
- B. The Contractor shall review the Site Plans, Floor Plans, Riser Diagrams, and Detail Sheets for additional work that is required to be performed by the Contractor of this section.
- C. Leviton / Berk-Tek manufacture the products that are used for the basis of design of this specification.
 1. Equivalent manufacture's solutions may be submitted for prior approval no less than 2 weeks before bid date closing. Products not submitted for prior approval shall be rejected.
 - a. Include with substitution request, a 3rd party verified testing agency's report which shall include, but not be limited to, the following TIA-568-C.2 tests:
 - 1) Insertion Loss / Attenuation.
 - 2) NEXT (Near End Cross Talk).

- 3) PSNEXT (Power Sum Near End Cross Talk).
 - 4) ACR (Attenuation Crosstalk Ratio).
 - 5) PSACR (Power Sum Attenuation Crosstalk Ratio).
 - 6) ACR-F (Attenuation Crosstalk Ratio – Far End)
 - 7) PSACR-F (Power Sum Attenuation Crosstalk Ratio – Far End)
 - 8) The following tests are only required for CAT6A cabling:
 - (a) PSANEXT (Power Sum Alien NEXT)
 - (b) PSAACRF (Power Sum Alien ACRF)
- D. All products shall be new, and brought to the job site in original manufacturer's packaging. Electrical components shall bear the Underwriter's Laboratories label. All Telecommunications cable shall bear the manufacturer's label in accordance with NEC 800 based on flammability testing as follows:
1. CMR General Purpose Communications Riser Cable.
 2. CMP Plenum-rated Communications Cable.
 3. And other cable ratings to comply with the National Electrical Code requirements for the installation.
- E. All products shall meet the certification requirements of the warranty. All device products and all cabling products shall be of a single manufacturer.
- F. Provide all equipment as defined in the specification(s) and shown on the drawings.

2.02 MATERIALS NOT INCLUDED (PROVIDED & INSTALLED BY OTHERS)

- A. Telephone switching equipment and related appurtenances.
- B. Telephones.
- C. Switchers, routers, network hubs, data concentrators and other similar active electronic equipment for data communications.
- D. Computers, printers, facsimile machines, modems and other similar utilization equipment.

2.03 SEISMIC BRACING

- A. Provide Seismic Bracing as required by the AHJ.
- B. This includes, but is not limited to:
 1. Racks.
 2. Cable Tray.
 3. Cable Supports.

2.04 TELECOMMUNICATIONS SYSTEM DESCRIPTION

- A. Provide Horizontal Cabling from each Telecommunication port to the MDF. Each Telecommunication Outlet type and style shall contain the quantity of Horizontal Cables identified on the Legend, unless noted otherwise.
- B. Horizontal cables are to be terminated on rack-mounted patch panels of the same data speed transfer rating. Horizontal Cabling shall be to Patch Panels within each designated rack. Horizontal Cabling shall be cross-connected to backbone cables.

- C. Modems, fax machines, wall mount voice outlets for telephone handsets, etc. shall be connected to the data and voice infrastructure via Horizontal Cabling.

2.05 LABELING

- A. See Section 27 00 00.01 for additional label type and additional requirements.
- B. The alpha-numeric labeling shall be developed by the Contractor, under the direction of the Port's IT Department at the Pre-Installation project kick-off meeting.
- C. The Contractor shall label all equipment and cables in an identical fashion of a sequential manner to the satisfaction of the Engineer.
- D. All label printing shall be machine generated using indelible ink ribbons or cartridges, and self-laminating labels shall be used on cable jackets appropriately sized to the outside diameter of the cable.
- E. All labeling shall match the final room number identification at completion of the project (not the room number that is indicated on the Bid Set of drawings). This includes, but is not limited to; the Outlets, Port Addresses, Patch Panels, As-Built Drawings, and Test Results.
- F. Patch panels shall have each port labeled to identify each outlet port.
- G. Racks shall have phenolic labels installed at the Top and Centered of EACH Rack installed on this project. Phenolic labels shall be size 36 font.
- H. Cable Identification Labels shall be placed in the following locations:
 - 1. Horizontal Cables. Each cable shall be identified and marked with the outlet port identification near the cable termination point at the rear of the patch panel and placed within view.
- I. Where telecommunications outlets are located above accessible ceiling space, provide a label directly on the ceiling tile grid indicating "TELECOM OUTLET ABOVE".

2.06 TELECOMMUNICATION OUTLETS

- A. Review the Site Plan(s), Floor Plan(s), Riser Diagram(s), and Detail Sheet(s) for all cable types and quantities required for this project.
- B. Each Telecommunication Outlet type and style shall contain the quantity of Horizontal Cables identified on the Electrical Legend, unless otherwise noted.
- C. Provide Horizontal Cabling from EACH Telecommunication Outlet port to the nearest MDF or designated IDF location.
- D. Telecommunication Outlet:
 - 1. Each Outlet shall accommodate individual modular ports and each modular port shall be individually removed without affecting any other port within the outlet.
 - 2. Coordinate the labeling requirements with the Port's IT department.
 - a. Outlet label identification information shall be typed text and indicate patch panel and port for each jack and shall comply with the Port's Labeling Standards. Hand written information will not be acceptable.
 - b. The Contractor shall match the color and finish of the devices specified in Section 26 27 26.01. Modify the model number if a different color or finish is identified in Section 26 27 26.01.

- c. 1-Port Stainless Steel Telecommunication Outlets, where shown on the plans, shall be manufactured by Leviton: Model # 43080-1L1, or approved equal. Provide quantities as required.
 - d. 4-Port Stainless Steel Telecommunication Outlets, where shown on the plans, shall be manufactured by Leviton: Model # 43080-1L4, or approved equal. Provide quantities as required.
 - 3. Surface Mount Outlet Locations shall only be installed above accessible ceiling spaces, the MDF Room, and designated IDF locations. They are not to be installed below the ceiling surface or exposed to view, unless approved in writing by the Engineer.
 - a. Provide modular single-port or dual port Surface Mount Outlet where indicated on the Plans. This includes, but is not limited to:
 - 1) Wireless Access Points.
 - 2) Projector Mounts.
 - 3) CCTV Cameras.
 - 4) Intrusion Alarm Control Panel.
 - 5) Access Control Panel.
 - 6) Energy Management Panels.
 - b. 1-Port Surface Mount Telecommunication Outlet, where shown on the plans, shall be manufactured by Leviton: Model # 41089-1IP, or approved equal. Provide quantities as required.
 - c. 2-Port Surface Mount Telecommunication Outlet, where shown on the plans, shall be manufactured by Leviton: Model # 41089-2IP, or approved equal. Provide quantities as required.
- E. Modular Inserts:
- 1. 8-position, 8-conductor (8P8C). Individual workstation port and patch panel port modules shall be Category 6 rated, 8-position, 8-conductor (8P8C) for termination of conductors and shall be approved by the manufacturer.
 - 2. 8-position, 8-conductor (8P8C). Individual Wireless Access port and patch panel port modules shall be green in color, Category 6A rated, 8-position, 8-conductor (8P8C) for termination of conductors and shall be approved by the manufacturer.
 - 3. EACH workstation port shall be Category 6 rated. Each workstation shall have (1) red, (1) blue, (1) white, and (1) yellow modular insert.
 - 4. Each Wireless Access port shall be Category 6A rated.
 - 5. Cables shall be wired in accordance with TIA/EIA-T568B, unless noted otherwise.
 - 6. Each individual insert shall be fully compatible with the face plates and patch panels provided.
 - a. Provide "DATA" identification icon tabs for each jack designated for data.
 - b. The Contractor shall match the color as shown on drawings.
 - c. Manufactured by Leviton: Model # 61110-R(X)6 Series for Category 6 applications, or approved equal for all workstation outlets. Provide quantities as required. (X) Indicates color.

- d. Manufactured by Leviton: Model # 6110G-R(X)6 Series for Category 6A applications, or approved equal for all Wireless Access point outlets. Provide quantities as required. (X) Indicates color.
 - 7. Blank inserts. Fill all remaining unused ports with a blank filler insert that is approved by the manufacturer.
 - a. The Contractor shall match the color and finish of the devices specified in Section 26 27 26.01. Modify the model number if a different color or finish is identified in Section 26 27 26.01.
 - 8. Manufactured by Leviton: Model # 41084BGB, or approved equal. Provide quantities as required.
- F. Wall Mount Telephone Outlet:
- 1. Provide modular single-port stainless steel wall phone outlet with mounting studs.
 - 2. Manufactured by Leviton: Model # 4108W-1SP, or approved equal. Provide quantities as required.

2.07 FIBER OPTIC CABLE TERMINATION HARDWARE

- A. Light Interface Unit (LIU):
- 1. MDF Room:
 - a. Provide rack-mount multi-capacity terminal that is capable of up to 144 fiber strands.
 - b. Provide label holders and color-coded labels.
 - c. Manufactured by Leviton: Model # 5R4UM-F12, or approved equal. Provide quantities as required. Provide all necessary appurtenances to terminate all fiber optic cables. This includes, but is not limited to:
 - 1) Provide fiber termination adapter panels for LC connectors.
 - (a) Manufactured by Leviton: Model # 5F100-2QL, or approved equal. Provide quantities as required to terminate each multimode fiber routed to the MDF.
 - (b) Manufactured by Leviton: Model # 5F100-2LL, or approved equal. Provide quantities as required to terminate each single mode fiber routed to the MDF.
 - (c) Provide blank cover(s) for each unused adapter panel's space manufactured by Leviton: Model # 5F100-PLT, or approved equal. Provide quantities as required.
 - 2) Provide retaining trough mounted underneath each LIU.

2.08 HORIZONTAL CABLE – INSIDE PLANT (ISP)

- A. See "Testing of Cables" listed elsewhere within this specification for Testing Requirements to be documented and submitted at the completion of this project.
- B. EACH Cable installed shall be rated for the appropriate application, such as; Riser Rated, Plenum Rated, Wet Rated, etc.
- C. Provide Horizontal Cabling from each Telecommunication Outlet to the MDF.
- D. Cable color codes shall be as follows.
- E. All horizontal data cable shall be blue in color.

- F. The work station Telecommunication Horizontal Cable shall be Category 6 rated, 4-pair, 23 AWG UTP, unless noted otherwise.
 - 1. Manufactured by Berk-Tek: Model # LANmark 1000 Series plenum rated cable for Category 6 applications, or approved equal.
- G. The Wireless Access Point Cable shall be Category 6A rated, 4pair, 23 AWG UTP, unless noted otherwise
 - 1. Manufactured by Berk-Tek: Model # LANmark-10G Series plenum rated cable for Category 6A applications, or approved equal.

2.09 PATCH PANELS – COPPER

- A. All patch panels shall be located at the MDF and shall be rack mounted unless specifically otherwise noted.
- B. Provide a minimum of 25 % spare patch panel jack capacity.
- C. Patch panels should be fully populated, avoiding blanks and empty ports (with the exception being the last patch panel in the series which may not be fully populated). Wireless access point shall be terminated onto the last ports of last patch panel.
- D. All Category 6 patch panels shall be tested and approved for Category 6 wiring, per TIA/EIA-568C; rear cable management bar and front labeling.
- E. Provide separate Patch Panels for the following equipment connection types:
 - 1. Data Cables.
- F. Patch panels:
 - 1. Manufactured by Leviton: Model # 4S255-S48 for 48 port, model #4S255-S24 for 24 port, or approved equal. The panel shall be field-configurable and shall accept a full range of modular connectors.

2.10 PATCH CABLES - COPPER

- A. The Patch Cables shall be Category 6 rated, 4-pair, 23 AWG UTP, unless noted otherwise.
- B. The outer cable jacket shall match the color selection of the Horizontal Cable Color identified in "Horizontal Cable".
- C. Provide a minimum quantity of (1) 15' equipment cord for EACH telecommunication outlet box shown in work areas. (Leviton # 62460-15L), or approved equal. See table below for MDF/IDF patch cord quantities.
- D. Upon completion of the project, the Data and Voice Infrastructure Contractor shall deliver the following patch cables:

The following items shall apply ONLY to the IT Room location.
--

Item #	Cable Length	Color	Quantity of Patch Cables (provide the following percentage of patch cables based on the Total patch panel Ports provided for this project) Unless noted otherwise.	manufactured by	Model #
1	3'	Blue	20%	Leviton	62460-03L
2	7'	Blue	60%	Leviton	62460-07L
3	9'	Blue	20%	Leviton	62460-09L

2.11 RACKS

- A. Rack Mount all equipment that is capable of being Rack Mounted.
- B. Middle Atlantic is the basis of design for all racks.
- C. Equivalent manufacture's solutions may be submitted for prior approval no less than 2 weeks before bid date closing. Products not submitted for prior approval shall be rejected.
- D. Provide seismic bracing for ALL RACKS per manufacturer's recommended instructions/accessories.
- E. Section 27 20 00.01 shall provide ALL Racks and related equipment, including but not limited to; Patch Panels, Patch Cords, Wire Management, Power Strip assemblies, etc. for ALL Local Area Network (LAN) bases Systems as shown on the site plans, floor plans, detail sheets, and riser diagrams.
- F. Racks:
 - 1. Free-Standing 2-Post:
 - a. The Rack shall have the following features:
 - 1) Complies with 19" wide rack EIA-310-D standards.
 - 2) Rack Height: 45RU.
 - 3) Color: Black.
 - b. Installation:
 - 1) Secure EACH Rack to the floor using the manufacturer recommended installation method and the manufacturers recommended hardware/bolt down kit.
 - 2) Secure EACH Rack to the Cable Tray using the manufacturer recommended installation method.

- 3) Provide vertical cable management between each rack
 - c. Manufactured by Middle Atlantic Products: Model # RL10-45.
 - 1) Provide the quantities where shown on the drawings.
- 2. Free-Standing 4-Post
 - a. The Rack shall have the following features:
 - 1) Complies with 19" wide rack EIA-310-D standards.
 - 2) Rack Height: 45RU.
 - 3) Color: Black.
 - b. Installation:
 - 1) Secure EACH Rack to the floor using the manufacturer recommended installation method and the manufacturers recommended hardware/bolt down kit.
 - 2) Secure EACH Rack to the Cable Tray using the manufacturer recommended installation method.
 - c. Manufactured by Middle Atlantic Products: Model # R412-4524B
 - 1) Provide the quantities where shown on the drawings
- G. Grounding Terminal Block for Rack: For EACH Rack provided for this project, provide one Grounding Terminal Block.
- H. Cable Management:
 - 1. Vertical Cable Management for open-frame racks: Provide vertical cable management on both sides of each rack. Where two racks are installed side-to-side, provide one section between the Racks for each Rack provided for this project.
 - a. Manufactured by Middle Atlantic Products: Model # DRK-44DUCT, or approved equal. Provide quantities as required.
 - 2. Horizontal Cable Management
 - a. Manufactured by Middle Atlantic Products: "HCM" series, or approved equal. Provide quantities as required.

2.12 CABLE MANAGEMENT TIES

- A. Wire ties of any type shall NOT be used anywhere in this installation.
- B. Bundle all Horizontal Cables together with Velcro-type tie wraps.
 - 1. Adjustable Velcro Straps shall be used for all cable bundles.
 - a. Provide Velcro Straps every two feet (approximately) above accessible ceilings, in Cable Trays (where applicable) and throughout the cable run.
 - b. Provide Velcro Straps every twelve-inches (approximately) within the MDF and each designated IDF location.
 - 2. Chatsworth Products Inc. (CPI): Model # 020XX-201, or approved equal. XX indicates actual length. "06" (6-inches long for two-inch diameter cable bundles), "09" (9-inches long for three-inch diameter cable bundles), and "12" (12-inches long for four-inch diameter cable bundles). Provide quantities as required.

2.13 TMGB (TELECOMMUNICATION MAIN GROUNDING BUSBARS)

- A. See Section 27 00 00.01 for additional Grounding requirements.
- B. Ground all equipment per the Manufacturers recommendations, per Division 26, and as required by Code.
- C. Provide grounding and bonding per ANSI-STD-J-607-A, which includes, but is not limited to: Cable Tray, Rack(s), conduit sleeves, and other equipment connected to the TMGB.
 - 1. The minimum conductor size shall be #6 green insulated copper grounding conductor. However, size each conductor shall be based on the actual cable length as defined in ANSI-STD-J-607-A.
- D. TMGB: Provide and install (1) 4" high x 20" wide Copper Telecommunication Main Grounding Busbar (TMGB). Use standoff brackets to wall mount the copper busbar and insulators.
 - 1. Manufactured by Chatsworth Products Inc (CPI): Model # 40153-020, or approved equal.
- E. Lug Style: EACH connection to the TMGB shall be a Copper 2-Hole Lug Straight Long Barrel Connection.
 - 1. Manufactured by Thomas & Betts: Model # 256 Series, or approved equal.

2.14 ADDITIONAL SYSTEM EQUIPMENT

- A. See Part 3 of this specification for additional provision of system Equipment and/or Labor.

PART 3 - EXECUTION

3.01 GENERAL

- A. See Section 27 00 00.01 Low Voltage Systems General Requirements for additional information.
- B. Prior to rough-in, coordinate with the Engineer for the exact location(s).
- C. Install all cabling, devices, and/or equipment per the manufacturer's recommendation.

3.02 PRODUCT INSPECTIONS

- A. The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of proper gauge, containing correct number of pairs, and is the material ordered. Any physical damage to the cable and wire must be noted; un-uniform jacket thickness and jacket tightness should also be identified. Note any buckling of the jacket, which would indicate possible problems.

3.03 CABLE INSTALLATION - GENERAL

- A. EACH CABLE RUN SHALL BE CONTINUOUS, WITHOUT ANY SPLICES, from the Telecommunications Outlet to the patch panel(s). Any cable run that does not meet this requirement shall be replaced at no additional cost to the Port.
- B. The Contractor shall insure that EACH Telecommunications cable is installed with care, using techniques which prevent kinking, sharp bends, scraping cutting, deforming the jacket, or other damage. During inspection evidence of such damage will result in the material being declared unacceptable. The Contractor shall replace unacceptable cabling at no additional cost to the Port.
- C. Conduit and Raceway Usage: All Telecommunications cable shall be installed in grounded metal conduit or raceway dedicated for Telecommunications purposes, when called for on the Project Drawings, and not to be shared with electrical wiring.

- D. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
- E. All wiring to be installed in a neat and inconspicuous manner and per local code requirements. Route wires parallel or perpendicular to the building structure using the specified cable supports. Wiring shall be installed near or on structural members as to minimize risk of physical damage by other trades or maintenance personnel servicing the equipment.
- F. Cable Lubricants specifically designed for installing Telecommunications cable may be used to reduce pulling tension as necessary when pulling cable into conduit. After installation, exposed cable and other surfaces must be cleaned of lubricant residue.
- G. Backboard and Rack Cable Supports: Clamps, "D-Rings", Velcro and tie-wraps are all acceptable ways to support cable. However, installation of these supports must be done with care so as not to cause crushing or distortion of the cable, nor cause tighter bends than the minimum radius permitted for each type cable.

3.04 HORIZONTAL CABLING

- A. Horizontal Cables shall be dressed and terminated in accordance with TIA/EIA-568-B requirements and the cable manufacturer's recommendations.
 - 1. Untwisting of pairs at the termination point shall not exceed one-half an inch for Category 6 connecting hardware.
 - 2. Bend radius of the cable in the termination area shall not be less than the manufacturer's recommendation.
 - 3. The Horizontal Cable jacket shall be maintained as close as possible to the termination point.
- B. Every attempt shall be made to avoid running Horizontal Cables close to (less than 24") and parallel to power raceway and wiring, or close to light fixtures.
- C. When an approved cable support is used to support cable bundles, all horizontal cables shall be supported at a maximum of four-foot intervals with UL approved cable support. At no point shall cables rest on acoustic ceiling grids or panels. Cables shall not be attached to ceiling grid or lighting support wires. Where light support for drop cable legs is required, the Contractor shall install clips to support the cabling.
- D. The installation of Horizontal Cables around moveable devices, instruments, subpanels, etc. shall be provided with adequate support, length, protection, and flexibility so that the cable is not damaged in the event the equipment is moved.
- E. Pathways:
 - 1. It is the responsibility of the contractor to ensure that ALL PATHWAYS for the permanent link of each balanced twisted pair cable shall not exceed 295' in length from work area outlet to telecommunications room patch panel.
 - 2. To ensure this length, all pathways shall be coordinated and installed prior to pouring of any slabs or the installation of any permanent structure which would inhibit a conduit or cable tray run from being installed after the structure is complete.
 - 3. See section 27 05 28.01 for pathway types and additional requirements.

3.05 PLYWOOD BACKBOARD CABLING

- A. Horizontal Cable installation must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance purposes such as access boxes, ventilation mixing boxes, access hatches to air filters, switch or electrical outlets, electrical panels, fire alarm equipment, clock systems, and lighting fixtures. Avoid crossing areas horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining maximum distance from these openings.
- B. Horizontal Cables shall be routed as close as possible to the ceiling, floor, or corners to insure that adequate backboard space is available for current and future equipment and for cable terminations. Horizontal Cables shall not be connected or attached to electrical conduit or other equipment. Minimum bend radius shall be observed.
- C. Lay cables via the shortest route directly to the nearest edge of the backboard from the mounted equipment or block. Velcro wrap all similar cables together and attached by means of clamps screwed to the outside edge(s) of the backboard vertically and/or horizontally, then route via "square" corners over a path that will offer minimum obstruction to future installations of equipment or other cables.
- D. Horizontal Cables that are not dressed in a neat fashion, or with excessive slack, will not be accepted.

3.06 CABLE LABELING

- A. Alpha-numeric numbering shall be developed by Contractor, under the direction of the Port's IT Department. Label all equipment and cables in an identical fashion.
- B. Patch Panel Labeling: Each terminal shall be identified and marked on the patch panel with the outlet port identification.
- C. Outlet Port Labeling: Outlet labels for each port shall be identified and marked on the Outlet with the outlet port identification.
- D. Backbone Labels: Labels shall be identified and marked on all backbone cables (at both ends of the cable) with an identifier as to the location of the beginning and termination of the each cable. Labels shall be attached to each cable at the point of entrance and exit to the IT Rooms.
- E. Horizontal Cables: Each cable shall be identified and marked with the outlet port identification near the cable termination point at the rear of the patch panel.

3.07 TELECOMMUNICATION ROOMS

- A. The Telecommunication Rooms (IT) shall house Racks, Patch Panels, Wire Management, UPS's, Punch Blocks, and required cable routing hardware. Racks shall be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side. If one mounting rail of the rack is placed against a wall, the mounting rail shall be no closer than 6" to the wall to allow room for vertical management. Where there is more than one rack, the racks shall be ganged with vertical management hardware to provide interlay management. Ganged rack frames will be placed in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces.
- B. Racks shall be installed in the following manner:
 - 1. EACH Rack shall be securely attached to the floor and/or wall using the manufacturer's recommended mounting hardware.

2. EACH Rack shall be Grounded/Bonded to the TMGB with a minimum size of one (1) #6 copper green insulated conductor or larger due to distance requirements based on ANSI-J-STD-607-A.
 3. Rack mount screws (#12-24) that are spare shall be bagged and left with the rack upon completion of the installation.
 4. All rack mounted equipment shall be installed in a designated Rack Unit. Equipment shall NOT be installed in between Rack Units; this will NOT be considered acceptable.
- C. Cable Tray: Configure as shown on the drawings. Provide Cable Tray as specified in 27 05 28. Install the Cable Tray using the manufacturer's recommended mounting hardware, connectors, brackets, and fasteners.

3.08 TESTING OF CABLES

- A. Notification shall be given a minimum of 14 days prior to any testing so that the testing may be witnessed by the Engineer.
- B. An ETL certified, TIA-1152 Level IIIe (ISO/IEC 11801 Level IV) Test Meter shall be used to test all balanced twisted-pair copper cabling.
- C. All labeling shall match the final room number identification at completion of the project (not the room number that is indicated on the Bid Set of drawings). This includes, but is not limited to; the Outlets, Port Addresses, Patch Panels, As-Built Drawings, and Test Results.
- D. Provide documentation of the following items of EACH Test Meter used:
 1. Calibration certification from a third party shall be within two-years of testing (at the time that the test is performed).
 2. Manufacturer of Test Meter.
 3. Model Number of Test Meter.
 4. Serial Number of Test Meter.
- E. Copper Cables – Category 6 and 6A Cables: Each of the pairs shall be tested from the Patch Panel or Punch Block to the Outlet. The Contractor shall test:
 1. Wire Map.
 2. Length.
 3. Insertion Loss / Attenuation.
 4. NEXT (Near End Cross Talk).
 5. PS-NEXT (Power Sum Near End Cross Talk).
 6. ACR-F Loss (Attenuation Crosstalk Ratio Far-end).
 7. PS ACR-F Loss (Power Sum Attenuation Crosstalk Ratio Far-end).
 8. Return Loss.
 9. Propagation Delay.
 10. Delay Skew.
 11. The following tests are only required for CAT6A cabling:
 - a. PSANEXT (Power Sum Alien NEXT)

b. PSAACRF (Power Sum Alien ACRF)

- F. The source of each error shall be determined, corrected, and the cable re-tested. All defective cables, connectors, connections, and related appurtenances shall be replaced and re-tested at no additional cost to the Port.
- G. Submit the Test Reports in PDF format.
- H. See the O & M Manual / As built Drawings requirements in this specification and also in Section 27 00 00.01 for additional requirements.
- I. Acceptance of these test procedures is predicated on the Contractor's use of the recommended products including, but not limited to; the specified cable type, patch panels, outlets, punch blocks, specified equipment identified in Part 2 and the installation standards of this specification. Adherence to these requirements shall be determined upon the completed installation and will be evaluated in the context of each of these factors.

3.09 FIRE RATED PENETRATIONS

- A. Install per manufacturers recommendations.
- B. Maintain all Code and AHJ requirements.
- C. See 27 0528 for additional requirements.

3.10 WARRANTY

- A. Upon final installation, a certificate providing a "Performance and Application Warranty" shall be provided to the Port. This warranty shall be valid for a period of no less than 25 Years. The warranty shall be direct to the end user, from the manufacturer, supported through the Contractor, and shall cover both materials and labor costs for any claims related to the warranty program.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. The provisions and intent of the Contract, including the General Conditions and General Requirements, apply to this work as if specified in this section. Work related to this section is described in:
 - 1. Section 26 00 00.01 "ELECTRICAL GENERAL CONDITIONS".

1.02 GENERAL

- A. The Fire Alarm System design for this project is based upon a Silent Knight Farenhyt IFP-1000 and accompanying components.
- B. Substitutions of the specified Fire Alarm will be considered providing that sufficient documentation is provided to the Engineer which certifies that the equipment and/or supplier qualification meets the requirements of this Specification Section.
- C. Includes, but not limited to, the following:
 - 1. Provide all material, labor, equipment, design, and services necessary to perform the installation of a complete, fully operational, intelligent (analog) and addressable (digital), low voltage 24 Volts D.C., point identification, microprocessor based Fire Alarm System, in accordance with the required and advisory provisions of the latest edition of N.F.P.A. #72 accepted by the Authority having Jurisdiction and project specifications, except as modified herein.
 - 2. The Contractor is to obtain a permit and final approval from The Authority Having Jurisdiction for the Fire Alarm System. All permits, fees for plan review, inspections, testing, etc. shall be included in the bid proposal.
 - 3. The Fire Alarm System Contractor shall simultaneously submit "Shop Drawings", Back-up Battery Calculations, Voltage Drop Calculations, Graphic Map Proof, and Equipment Submittals to the local Authority Having Jurisdiction and Engineer for review and shall be approved by the Engineer prior to the purchase, fabrication, or installation of any system components as detailed in paragraph 1.14 of Specification Section 28 31 00.01.

1.03 RELATED DOCUMENTS

- A. Drawings, General Conditions and Supplementary Conditions of the Contract, including Division 0 and Division 1 Specification Sections apply to work of this Division.

1.04 CODES AND STANDARDS

- A. Codes and agencies having jurisdictional authority over Fire Protection installations.
 - 1. International Building Code – Latest Adopted Edition.
 - 2. International Mechanical Code – Latest Adopted Edition.
 - 3. International Fire Code – Latest Adopted Edition.
 - 4. Authority Having Jurisdiction (Local Fire Marshal).
 - 5. Occupational Safety and Health Administration (OSHA).
 - 6. Washington Industrial Safety and Health Act (WISHA).
 - 7. National Fire Protection Association (N.F.P.A.) (i.e. Article 760 of N.F.P.A. #70, etc.).
 - 8. Telecommunications Architectural Standards - In Washington State Government (Latest Adopted Edition).

9. ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications.
10. Americans with Disabilities Act (ADA).
11. State of Washington Administrative Code (WAC).
12. State of Washington Labor & Industry (L&I).
13. Revised Code of Washington (RCW).
14. U.L. Fire Protection Equipment Directory
15. Underwriters Laboratories Incorporated (U.L.)
 - a. UL 38 Manually Actuated Signaling Boxes
 - b. UL 50 Cabinets and Boxes
 - c. UL 217 Smoke Detectors, Single and multiple Station
 - d. UL 228 Door Closers-Holders for Fire Protective Signaling Systems
 - e. UL 268 Smoke Detectors for Fire Protective Signaling Systems
 - f. UL 464 Audible Signaling Appliances
 - g. UL 521 Heat Detectors for Fire Protective Signaling Systems
 - h. UL 864 Control Units for Fire Protective Signaling Systems
 - i. UL 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
 - j. UL 1481 Power Supplies for Fire Protective Signaling Systems
 - k. UL 1638 Visual Signaling Appliances
 - l. UL 1971 Standard of Safety for Signaling Devices for the Hearing Impaired
 - m. UL 60951 Safety on Information Technology Equipment

1.05 GENERAL SYSTEM REQUIREMENTS

- A. Provide and install a new, complete, fully operational intelligent (analog) and addressable (digital), low voltage 24 Volts D.C., point identification, microprocessor-based Fire Alarm System, as described herein, and as shown on the contract documents.
- B. The New Fire Alarm System shall include, but not be limited a control panel, power supplies, peripherals, initiating devices, notification appliances, wiring, conduit, junction boxes, fittings, wire, raceways, termination at field devices and panels, etc. required for a complete operating system even though each item may not be specifically mentioned or described in this specification section or on the contract documents.
- C. Devices and equipment for Fire Alarm System service shall be U.L. listed and Factory Mutual Global approved for use in Fire Alarm Systems and of the manufacturer's current model.
- D. The New Fire Alarm Control Panel shall be listed under U.L. Category UOJZ as a single control unit, and shall be U.L. Listed for Power Limited Applications per Article 760 of N.F.P.A. #70 (National Electrical Code).
- E. The New Fire Alarm Control Panel shall electrically supervise and monitor the integrity of all conductors of all circuits.

- F. The New Fire Alarm System Control Panel and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
- G. The New Fire Alarm shall be of modular design to facilitate both expansion and service.
- H. The New Fire Alarm System shall operate as a low voltage "Class B" Fire Alarm System.
- I. The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the New Fire Alarm control panel indicating that the device and associated circuit wiring is functional.

1.06 COORDINATION

- A. The work covered by this Specification Section shall be coordinated with the related work as specified elsewhere on the contract documents or in the project specifications.
- B. The Contractor shall participate in the on-site coordination meetings to coordinate the Fire Alarm System installation with the Architectural features, H.V.A.C. grilles, electrical lights, fire protection sprinkler heads, and/or existing conditions.
- C. Coordination meetings shall consider elevations, required clearances, and routings of all trades to assure that all trades can be installed without conflict.
- D. The outcome of this coordination shall allow each system (Electrical, Mechanical, Fire Protection, etc.) to be installed without further conflicts for space or locations.
- E. Failure to coordinate with other trades and/or existing conditions that result in the removal and re-installation of systems shall not be charged as additional costs.

1.07 SYSTEM/DEVICE INTERFACE CONNECTIONS

- A. The following system/device interfaces shall be connected to the Fire Alarm System for auxiliary functions initiated by an "Alarm" condition at the New Fire Alarm System Control Panel and includes, but is not limited to:
 - 1. Fire Protection Sprinkler System
 - 2. H.V.L.S. Fans
 - 3. P.A. System

1.08 SITE INSPECTIONS OF EXISTING BUILDINGS OR SITE CONDITIONS PRIOR TO BIDDING

- A. The Contractor shall examine premises and understand the existing conditions that may affect performance of contractor's work of this Division before submitting proposals and/or bids for this work.
- B. No subsequent allowance for time or costs will be considered for any consequence related to failure to examine site conditions.

1.09 CONTRACT DOCUMENTS

- A. Fire Alarm System contract documents show general arrangement and locations of all devices and/or wiring arrangements. It is the contractor's responsibility to provide devices that may not be indicated or shown on the contract documents to make a fully functional system.
- B. The Fire Alarm System installation shall be made in accordance with the drawings, specifications, and applicable standards. Should a conflict occur between the drawings and specifications, the specifications shall prevail, refer to Division 1.
- C. In the case that criteria contained on the drawings is omitted from the specifications or the specifications have criteria that is omitted from the drawings, the criteria given in one location

shall apply as if shown in both the drawings and in the specifications (what's in one document applies to both documents). The drawings and specifications are complementary and what is called for in either is binding as if called for in both.

1.10 SYSTEM OPERATION

A. Alarm Detection:

1. By actuation of any Fire Alarm Initiating Device, the following shall occur:
 - a. Transmit an alarm signal to the master campus fire alarm control panel via fiber optic connection.
 - b. Display the device location unique nomenclature (for each addressable and non-addressable point in the system) on the Fire Alarm Control Panel (FACP) LCD Display.
 - 1) All points of identification shall clearly indicate the device type, the room name, number and location in the area or room.
 - c. The system alarm LED on the system display shall flash.
 - d. A local piezo electric signal in the control panel shall sound.
 - e. Activate the Interior Horn/Strobes and/or Strobes (where shown on the drawings).
 - f. All strobes shall be synchronized throughout the facility, and meet or exceed all ADA requirements.
 - 1) Automatically report the alarm point/device information to the main fire alarm control panel.
 - g. The history event storage shall log the information associated with each fire alarm control panel condition, including the time and date of occurrence.
 - h. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated System Outputs (Alarm Indicating Appliances and/or relays) shall be activated. Unacknowledged alarm messages shall have priority over trouble messages, and if such an Alarm occurs during a Trouble sequence, the Alarm condition will have display priority.
2. Upon activation of any Initiating device (manual stations, automatic detectors, etc.) all alarm Notification devices (horns, visual alarm lamps, etc.) shall operate continuously until the fire alarm control panel has been 'silenced'.
3. Alarm circuits shall remain energized until the acknowledge switch is operated at which time the audible signaling devices will be de-energized. Should an alarm be initiated after an alarm has been acknowledged, the alarm signals shall be re-energized. The control panel shall be restored to normal by operation of a reset switch after the initiating device has been restored to normal.

B. Trouble Detection: When a trouble condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. Transmit a trouble signal to the master campus fire alarm control panel via fiber optic connection.
2. The System Trouble LED shall flash.
3. A local Piezo electric signal in the control panel shall sound.

4. The 80-character LCD display shall indicate all information associated with the Fire Alarm trouble condition, including: type of trouble point, its location within the protected premises, and the time and date of that activation.
5. Unacknowledged alarm messages shall have priority over trouble messages, and if such an Alarm occurs during a Trouble sequence, the Alarm condition will have display priority.
- C. Supervisory Detection: When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 1. The system trouble LED shall flash.
 2. A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 3. The 640-character backlit LCD display shall indicate all information associated with the "Supervisory" condition, including:
 - a. Type of "Supervisory" point.
 - b. Location of "Supervisory" point within the protected premises.
 - c. Time of the "Supervisory" condition.
 - d. Date of the "Supervisory" condition.
- D. Functional Operation:
 1. The system shall operate as a low voltage, Intelligent, point identification fire management system. The fire detection control system shall monitor Intelligent and Addressable (Digital) devices, point identify the alarm location and transmit a signal to the monitoring agency.
 2. The fire alarm control panel shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes. All software operation shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory
 3. The control panel shall provide, or be capable of expansion to 636 intelligent/addressable devices.
 4. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
 5. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
 6. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
 7. The FACP shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life.
 - b. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

- c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. The ability to display system reports.
 - f. PAS presignal, meeting NFPA 72 3-8.3 requirements.
 - g. Periodic detector test, conducted automatically by the software.
 - h. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
 - i. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
8. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2). Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation. Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

E. Control Panel Operation:

- 1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
- 2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
- 3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
- 4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values
 - e. Device zone assignments
 - f. All program parameters
- 5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.

6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. Walk Test: The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
11. Operator Control:
 - a. Acknowledge Switch:
 - 1) Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
 - 2) Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
 - b. Alarm Silence Switch:
 - 1) Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by

this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

c. Alarm Activate (Drill) Switch:

- 1) The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset. By activating this function, it shall NOT initiate the Municipal System or Dialer.

d. System Reset Switch:

- 1) Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

e. Lamp Test:

- 1) The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

1.11 QUALITY ASSURANCE

- A. Each and all items of the Fire Alarm System shall be listed as a product of the SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the UL label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial or pending listings shall not be acceptable.
- B. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC Article 760. All circuits must be marked in accordance with NEC Article 760-23.
- C. All fire alarm equipment shall be of a single supplier and installed by an authorized factory distributor, to ensure proper component application, system uniformity, and the availability of prompt, emergency service by factory trained technicians.
- D. Suppliers interested in furnishing substitute systems shall furnish to the Engineer a Riser Diagram showing size, number, type and arrangement for all interconnecting wiring with the request, for prior approval to bid. This Riser shall also be furnished to each interested bidding contractor during the bidding period.
- E. The system subcontractor for this Fire Alarm System shall be currently listed and approved by Underwriters Laboratories, Inc. Certificate Service for Protective Signaling Services--Local, Auxiliary, Remote Station and Proprietary Signal System Listing Program. Proof of this listing shall be included with all prior approval requests. At the request of the Engineer, an UL certificate specific to this installation shall be furnished by the Fire Alarm System Sub-Contractor. The U.L. certificate shall be issued only by Fire Alarm System Sub-Contractor. Certificates issued by any company not directly associated with the installation of this project will be rejected.
- F. The equipment and installation shall comply with the current applicable provisions of the following standards:
 1. National Electric Code
 2. National Fire Protection Standards:
 - a. NFPA 71 Central Station Signaling Systems-Protected Premises Unit.

- b. NFPA 72 National Fire Alarm Code
 - c. NFPA 70 National Electric Code
- 3. ADA Americans with Disabilities Act
- 4. ANSI A117 Washington Barrier Free Regulations
- G. All requirements of the Local Authority Having Jurisdiction.
- H. If any conflicts occur between government adopted codes/rules and the drawings, the codes are to govern.
- I. The system and all components shall be listed by Underwriters Laboratories, Inc. for use in fire protective signaling systems under the following standards as applicable:
 - 1. UL 38 Manually Actuated Signaling Boxes
 - 2. UL 50 Cabinets and Boxes
 - 3. UL 228 Door Closer-Holders for Fire Protective Signaling Systems.
 - 4. UL 268 Smoke Detectors for Fire Protective Signaling Systems
 - 5. UL 268A Smoke Detectors for Duct Applications
 - 6. UL 346 Waterflow Indicators for Fire Protective Signaling Systems.
 - 7. UL 464 Audible Signaling Appliances
 - 8. UL 521 Heat Detectors for Fire Protection
 - 9. UL 864 Control Units for Fire Protective Signaling System
 - 10. UL 1481 Power Supplies for Fire Protective Signaling Systems
 - 11. UL 1971 Visual Notification Appliances

1.12 SHOP DRAWINGS

- A. Prepare detailed working drawings that are not larger than the contract documents for the system layout in accordance with N.F.P.A. #72.
- B. All items contained in Section 7.4 "Shop Drawings" of the latest edition of N.F.P.A. #72 adopted by the Authority Having Jurisdiction shall be included on the Fire Alarm System Shop Drawings including, but not limited to the following:
 - 1. Sheet Index.
 - 2. Fire Alarm System Component Legend.
 - 3. Cabling Legend.
 - 4. Alpha-numeric labeled cables based upon the "Cabling Legend" for each cable type and cable run.
 - 5. Electrical Legend listing the electrical devices to be utilized as part of the Fire Alarm System installation.
 - 6. Site Plan.
 - 7. Floor Plans indicating all Fire Alarm System devices.
 - 8. End-Of-Line Resistor(s) where applicable.
 - 9. Device Address shown adjacent to each device.

10. One-Line Riser Diagram with all field devices and their respective room names, room numbers and device address.
 11. "Sequence of Operations" matrix indicating all system Inputs and Outputs.
 12. Mounting details and mounting heights
- C. The Contractor is responsible for assuring that the conduit size and wire quantity, size, and type is suitable for the equipment supplied. The Contractor shall review the proper installation of each type of device with the manufacturer's representative.
 - D. Provide "Shop Drawings" that are usable for trouble-shooting purposes showing equipment/device locations, conduit routing, junction boxes, connection cabling for the entire Fire Alarm System layout, and riser diagrams.
 - E. Shop Drawings shall be clear and legible with a minimum text height of 1/8" for all text.
 - F. A graphical scale shall be provided for each floor plan or detail on the shop drawings in accordance with N.F.P.A. #72.
 - G. Projects that require more than one sheet to show the entire Fire Alarm System shall require a key plan.
 - H. The key plan shall identify the location of the Fire Alarm System that is contained on that sheet and shall contain a reference north arrow.
 - I. All sheets that contain a break in the building background shall contain a "Match Line" designation to indicate where the building and Fire Alarm System continue, even if on the same sheet.

1.13 SUBMITTALS

- A. "Shop Drawings", Back-up Battery Calculations, Voltage Drop Calculations, Sound Calculations, and the Graphic Map(s) for the Fire Alarm System shall be submitted to the Engineer for review and approval.
- B. Submittals shall include floor plans with fire alarm equipment, point to point wiring diagrams, zoning, backup battery calculations, voltage drop calculations, one line risers, equipment specification sheets, sequence of operations matrix, and graphic map details/artwork.
- C. Graphic Maps shall be presented for review and approval.
- D. Equipment submittals shall be broken up by "Tabbed Dividers" that shall include, at a minimum, the following:
 1. Fire Alarm System Control Panel.
 2. Fire Alarm Remote Annunciator Panels.
 3. Power Supplies.
 4. Initiating Devices.
 5. Notification Appliances.
 6. Graphic Maps.
 7. Modules.
 8. Miscellaneous Equipment.
- E. Equipment submittals shall include, at a minimum, the following:

1. Fire Alarm System Control Panel.
 2. Fire Alarm System Control Panel Enclosures.
 3. Fire Alarm System Terminal Cabinets
 4. Fire Alarm Remote Annunciator Panels.
 5. Main Fire Alarm System Control Panel Power Supplies.
 6. Remote Audible / Visual Power Supplies.
 7. Back-Up Batteries.
 8. Internal Battery Chargers.
 9. External Battery Chargers.
 10. Initiation Devices:
 - a. Manual Pull Stations.
 - b. Heat Detectors.
 - c. Smoke Detectors.
 - d. Carbon Monoxide Only Detectors.
 11. Notification Appliances:
 - a. Strobe Only Appliances.
 - b. Combination Horn / Strobe Appliances.
 12. Graphic Maps.
 13. Monitor Modules.
 14. Relay Modules.
 15. Multi-Voltage Relay Modules (Relay in Box).
 16. Isolation Modules.
 17. Network Node.
 18. Integration Network.
 19. Universal Digital Alarm Communicator Transmitter (UDACT).
 20. Transient Voltage Surge Protection.
 21. Wet Rated Cables.
- F. Shop drawing submittals shall include the following information:
1. Floor plans identifying all Fire Alarm System components and devices.
 2. Cabling / conduit routing and sizing.
 3. Fire Alarm System zoning.
 4. Point to point cabling diagrams.
 5. One-line risers.
 6. Back-up Battery Calculations.

7. Voltage Drop Calculations.
 8. Graphic Map Details / Artwork
- G. If the submittals are being delivered electronically, the Fire Alarm System Contractor shall provide the following:
1. Equipment Submittals:
 - a. The Equipment Submittal shall be a single PDF.
 - b. The Equipment Submittal PDF shall contain all equipment, devices, and components that are collated for printing on 8½"x11" sized paper.
 - c. The Equipment Submittal PDF shall be a searchable document.
 - d. The Equipment Submittal PDF shall be formatted for duplex printing with blank sheet inserted where necessary.
 - e. The Equipment Submittal PDF shall contain a "Table of Contents" that indicates all pieces of equipment, devices, and components contained within each "Tabbed Divider" defined in Paragraph 1.13.G of this Specification Section.
 - f. The Equipment Submittal PDF shall be bookmarked by "Tabbed Divider" and for each piece of equipment, device, and component.
 2. Back-Up Battery Calculations and Voltage Drop Calculations that are submitted as part of the Equipment Submittal PDF shall be formatted to the following:
 - a. Calculations shall be included at the end of the Equipment Submittal PDF under a separate "Tabbed Divider" for both Back-Up Battery Calculations and the Voltage Drop Calculations.
 - b. The Equipment Submittal "Table of Contents" shall also indicate all calculations being provided for both the Back-Up Battery and the Voltage Drop Calculations
 3. Back-Up Battery Calculations and Voltage Drop Calculations that are submitted as a separate PDF from the Equipment Submittal PDF:
 - a. The single Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall contain all calculations that are collated for printing on 8½"x11" sized paper.
 - b. The Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall be a searchable document.
 - c. The Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall be formatted for duplex printing with blank sheet inserted where necessary.
 - d. The Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall contain a "Tabbed Divider" to separate the Back-Up Battery Calculations from the Voltage Drop Calculations.
 - e. The Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall contain a "Table of Contents" that indicates all calculations contained within each "Tabbed Divider" defined in Paragraph 1.13.L.3.d of this Specification Section.
 - f. The Back-Up Battery Calculations and Voltage Drop Calculations submittal PDF shall be bookmarked by "Tabbed Divider" and for each Back-Up Battery Calculation or Voltage Drop Calculation.
 4. Graphic Maps:

- a. Graphics Maps shall be submitted in a PDF that is full sized to allow printing of actual sized proposed Graphics Maps.
- H. Any material found to be installed without prior approval will be required to be removed and replaced with only specified approved material at Contractor's cost.
- I. The contract documents shall not be used as the Fire Alarm System Contractor's Shop Drawings.
- J. The Fire Alarm System Shop Drawings shall be system specific with only Fire Alarm System equipment and connections to other equipment that will be interfaced to the Fire Alarm System being shown.

1.14 SERVICE

- A. The equipment manufacturer representative shall have a local office staffed with trained, full-time employees who are capable of performing testing, inspection, repair maintenance services, and inventory parts.
- B. This organization must have a minimum of five (5) years of experience servicing fire alarm systems and shall respond to service calls within 48 hours during or after the warranty period.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The fire alarm system design is based on equipment as manufactured by Silent Knight Farenhyt 1FP-1000. Any changes resulting from differences between the specified product and substitute manufacturers shall be the responsibility of the contractor as specified under the Division 01 requirements.
- B. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system.
- C. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation.
- D. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.02 FIRE ALARM CONTROL PANEL (FACP)

- A. The Fire Alarm Control Panel shall be provided with the capacity to serve the current design plus an additional 25% capacity to support future expansion or renovation.
- B. Central Processing Unit:
 - 1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
 - 2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
 4. A special program check function shall be provided to detect common operator errors.
 5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
 6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.
 7. Event Logger:
 - a. 1,000 Event Capacity in non-volatile memory.
 - 1) Additional separate 200 Event Capacity alarm only file.
 - b. Remote event retrieval.
 - c. Log opening/closings by user.
 - d. Log fire tests.
 - e. Log alarms, troubles, and restorals.
- C. Fire Alarm System Display:
1. The system shall support the following display mode options:
 - a. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.
 2. The display shall provide all the controls and indicators used by the system operator:
 - a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
 3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
 4. The display shall also provide Light-Emitting Diodes.
 - a. The 80-character display shall provide 12 Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, ALARM SILENCED, Controls Active, Pre-Discharge, Discharge and Abort.
 5. The display shall have QWERTY type keypad.
 - a. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the

capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

6. The system shall support the display of battery charging current and voltage on the 80-character LCD display.

D. FACP Internal Power Supply:

1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED.
 - b. AC Power Fail LED.
 - c. NAC on LED (4).
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
7. All circuits shall be power-limited, per UL864 requirements.

E. Signaling Line Circuits (SLC):

1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

F. Field Programming:

1. The system shall be programmable, configurable, and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits. All programming shall be accomplished through the

standard common control panel keyboard. All field defined programs shall be stored in non-volatile memory.

2. The programming function shall be enabled with a special 5-digit password that may be defined specifically for the system when it is installed.
3. This password may be changed to a new value at any time by the Installing Contractor. In the event that the Installing Contractor may define a password and then lose or forget it, the system shall be designed so that the valid password may be determined by special procedures available through the system manufacturer.
4. The system shall provide means for automatic programming of its operation to conform to certain N.F.P.A. Standards through internal software. The following N.F.P.A. operations are to be available through this means:
5. NFPA 72: National Fire Alarm Code.

2.03 FIRE ALARM REMOTE ANNUNCIATOR PANEL (FARAP)

- A. A Fire Alarm Remote Annunciator Panel shall be provided in the locations indicated on the contract documents.
- B. The Fire Alarm Remote Annunciator Panel(s) shall be programmed to clearly indicate the exact same information that is displayed at the Fire Alarm Control Panel and shall be protected from unauthorized use by a key switch or password.
- C. The alphanumeric display annunciator shall be a supervised back-lit Liquid Crystal Display (LCD) containing a minimum of (80) eighty characters for visual annunciation of Alarm and Trouble conditions.
- D. The Fire Alarm Remote Annunciator Panel shall be provided with an integral piezo sounder for audible indication of an Alarm or Trouble conditions.
- E. The Fire Alarm Remote Annunciator Panel shall be UL listed for Fire Alarm application with an On-line/Power Light Emitting Diode (LED).
- F. The Fire Alarm Remote Annunciator Panels shall be capable of the following system functions:
 1. Acknowledge.
 2. Signal Silence.
 3. System Reset.

2.04 FIRE ALARM POWER SUPPLY(S) (FAPS)

- A. The Fire Alarm Power Supply(s) for the Fire Alarm System shall provide 6 or 8 amperes of unregulated 24 VDC power for Audio-Visual alarm Notification devices. Provisions will be made to allow the Audio-Visual power to be increased, by the addition of more Fire Alarm Power Supplies (FAPS)'s as required. All FAPS's shall be designed to meet UL and NFPA requirements for power-limited operation on all external circuits.
- B. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs.
- C. Input power shall be 120 VAC, 60 HZ. The power supply shall be capable of being backed up with a standby battery, or may be used with external battery and charger systems. Battery arrangement may be configured in the field. All standby power connections shall be supervised. All FAPS's shall have automatic switch over to stand-by batteries when AC power fails, and have AC fail supervision which is a Form "C" contact closure upon loss of power.

- D. At a minimum, provide at locations as shown on the drawings. If additional FAPS's are needed, provide the quantities as required for a fully functional system, while maintaining the design requirements that are defined elsewhere in these specifications.

2.05 TRANSIENT AND SURGE PROTECTION

- A. If not provided as an integral part of the system power supply, and external, 120 Volts A.C. transient and surge protection shall be provided for all components of the system.
- B. Protector shall be UL listed under sections 1449, 1283, and 497A, have a minimum energy handling of 70 Joules on line to line, line to neutral, and line to ground spikes.
- C. Response time shall be 5 nanoseconds or less, and shall begin at 140 Volts A.C.
- D. Provide (1) one dedicated TVSS at each 120 Volts A.C. hard-wired connection point.

2.06 BATTERY BACKUP FOR COMPLETE SYSTEM OPERATION

- A. Battery back up power shall be an integral part of the Fire Alarm System.
- B. Prior to bidding, it shall be the Contractor's responsibility to confirm that the proposed fire alarm system will meet or exceed the local Authority Having Jurisdiction (AHJ) requirements for battery back up power. At a minimum, provide battery back up power for the entire Fire Alarm system to provide 24 hours of standby operation, and a minimum of 5 minutes of alarm operation. Batteries shall be sized to provide at least 25% spare capacity.
- C. Provide and install gel-cell, maintenance free batteries for the FACP and EACH FAPS that is provided. Provide quantities as required for maintaining or exceeding the submittal calculation requirements.
- D. The FACP and EACH FAPS shall have automatic switch over to stand-by batteries when AC power fails. The power supply/charger shall be an integral portion of the control panel and/or power supply and be capable of charging fully discharged system batteries to 100% in 8 hours.
- E. All batteries shall be placed inside a key lockable, metal enclosure that is approved by the manufacturer.
- F. Each battery shall have the date of installation written on the battery with a permanent marker. The date shall be legible and clearly written in one-inch numbers and be visible when the enclosure door is open.

2.07 UNIVERSAL DIGITAL ALARM COMMUNICATOR TRANSMITTER (UDACT)

- A. The Universal Digital Alarm Communicator Transmitter (UDACT) is an interface for communicating digital information between a fire alarm control panel and on UL-Listed central station..
- B. The Universal Digital Communicator Transmitter (UDACT) shall be compact in size and mounted in a standard module position of the Fire Alarm System Control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
- C. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
- D. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.

- E. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
- F. The UDACT shall include vital system status such as:
 - 1. Independent zone (alarm, trouble, non-alarm and supervisory).
 - 2. Independent addressable device status.
 - 3. AC (Mains) power loss.
 - 4. Low battery and earth fault.
 - 5. System off normal.
 - 6. 12 and 24 hour test signal.
 - 7. Abnormal test signal (per UL requirements).
 - 8. EIA-485 communication failure.
 - 9. Phone line failure.
- G. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
- H. An IP Communicator option shall be available to interface to the Universal Digital Communicator Transmitter (UDACT) and be capable of transmitting signals over the internet/intranet to a compatible receiver.

2.08 FIELD DEVICES

- A. Addressable Manual Pull Stations: The manual pull stations shall be intelligent, addressable, and shall connect to one of the fire alarm control panel signaling line circuit (SLC) loops. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch. Manual fire alarm stations shall be double action type with a key operated test-reset lock, and shall be designated so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
 - 1. All operated stations shall have a positive, visual indication of operation that cannot be reset without the use of a key. The word FIRE shall appear on the front of the stations in raised letters.
 - 2. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting on a standard single gang box. The manual stations shall provide address-setting means using rotary decimal switches and shall also store an internal identifying code, which the control panel shall use to identify the type of device.
 - 3. An LED shall be provided which shall flash under normal conditions, indicating that the manual station is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. The station shall provide a key reset. The key shall be the same as used for the fire control panel.
- B. Addressable Photoelectric Smoke Detectors: The photoelectric detectors shall be intelligent, addressable, and shall connect to one of the fire alarm control panel signaling line circuit (SLC) loops. The detectors shall use the photoelectric principle to measure smoke density and shall,

on command from the control panel, send data to the panel representing the analog level of smoke density.

1. The detectors shall be ceiling mount and shall include a twist-lock base.
2. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself or may be activated remotely on command from the control panel. The detectors shall provide address-setting means on the detector head using rotary decimal switches. The detectors shall also store an internal identifying code, which the control panel shall use to identify the type of detector.
3. The detectors shall provide dual alarm and power LED's. Both LED's shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of detector LED's shall be controlled through the system field program. An output connection shall also be provided in the base to connect an external remote alarm LED.
4. The detector sensitivity shall be set through the fire alarm control panel, and shall be adjustable in the field through the field programming of the system.

C. Monitor Modules:

1. Monitor modules shall be listed to UL #864 for control units and accessories for fire alarm systems and FM-ANSI/N.F.P.A. #72 National Fire Alarm Code and shall be approved for fire protection service.
2. Provide an addressable monitor module for each Specialty System connection (as required) and to connect one supervised Initiating Device Circuits (IDC) or zone of conventional alarm initiating devices (any Normally Open (N.O.) dry contact device) to one of the Fire Alarm or System Control Panel Signaling Line Circuits (SLC).
3. Module shall have ability to uniquely signal an open circuit.
4. The Initiating Device Circuits (IDC) zone shall be suitable for Class "B" operation.
5. For multiple dry contact monitoring, the monitor module shall be available that provides a minimum of 5 input circuits.
6. Monitor module wiring connections shall be made by means of Pre-Assembled Washers and Screws (SEMS).
7. The monitor module shall provide address-setting means using rotary decimal switches and shall also store an internal identifying code, which the fire alarm control panel shall use to identify the type of device.
8. Systems that require a special programmer to set the monitor module address (including temporary connection at the panel) are labor intensive and not acceptable.
9. The module shall have a Light Emitting Diode (LED) that is controlled by the Fire Alarm System Control Panel to indicate module status.
10. Coded signals, transmitted from the Fire Alarm System Control Panel, can cause the Light Emitting Diode (LED) to blink, latch on, or latch off.
11. The Specialty System connections shall include Alarm, Trouble, and Supervisory outputs of the following equipment:

a. Hood Suppression

D. Addressable Relay Modules:

1. Relay modules shall be listed to UL #864 for control units and accessories for fire alarm systems and FM-ANSI/N.F.P.A. #72 National Fire Alarm Code and shall be approved for fire protection service.
2. Addressable Relay Modules shall allow a compatible Fire Alarm System Control Panel to switch discrete contacts by code command.
3. The Relay Module shall provide (2) two isolated sets of Form-C contacts, which operate as a double pole double throw switch and rated at up to 3.0 Amps resistive and up to 2.0 Amps inductive.
4. The Relay Module shall allow the Fire Alarm System Control Panel to switch these contacts on command.
5. The Relay Module shall not provide supervision for the notification appliance circuit (NAC).
6. Relay Module shall have both normally open and normally closed connections available for field wiring.
7. Addressable Relay Modules shall be available for H.V.A.C. control and other building functions.
8. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires.
9. The Relay Module shall provide address-setting means using rotary decimal switches and shall also store an internal identifying code, which the fire alarm control panel shall use to identify the type of device.
10. Systems that require a special programmer to set the Relay Module address (including temporary connection at the panel) are labor intensive and not acceptable.
11. The module shall have a Light Emitting Diode (LED) that is controlled by the Fire Alarm System Control Panel to indicate module status.
12. Coded signals, transmitted from the Fire Alarm System Control Panel, can cause the Light Emitting Diode (LED) to blink, latch on, or latch off.
13. Relay Module wiring connections shall be made by means of Pre-Assembled Washers and Screws (SEMS).
14. Relay modules shall be provided at the following locations:

a. Audio System

- E. Horn/Strobe (High Intensity): Combination horn/strobe unit shall be 24 VDC, white, and compatible with the control panel. The horn shall have field selectable sounds, a minimum of 100 DB at 10 feet, screw terminals and can operate independent of the strobe. The strobe shall be xenon flash tube type rated at a minimum candela to meet or exceed the requirements of the Americans with Disabilities Act (ADA).
1. Combination units shall be suitable for surface mountings on a matching back box or semi-flush mounting on a standard 4" square box.

- F. Ceiling Mounted Horn/Strobe: Ceiling mount horn/strobe shall be 24 VDC, white, and compatible with the control panel. Strobes shall be xenon flash tube type rated candela to meet or exceed ADA requirements.
- G. Strobe Only: Strobes shall be 24 VDC, white, and compatible with the control panel. Strobes shall be xenon flash tube type rated at 15 candela minimum and meet or exceed ADA requirements.
- H. Weatherproof Horn/Strobe: Weatherproof horn/strobe shall be 24 VDC, red, and compatible with the control panel and rated for outdoor use. Use the following part numbers for EACH device location.

2.09 SPARE CAPACITY

- A. Spare capacity to add additional devices in the future shall be an integral part of the system design.
- B. Within the building:
 - 1. Low Voltage Power – Regardless of where the low voltage circuit is in the building, each individual cable run shall not exceed 80% of the Amp Draw load capacity of each run.
 - 2. Addressable Devices – The system design should be able to add no less than Twenty (20) additional addressable devices.

2.10 FLEXIBILITY IN SYSTEM DESIGN LAYOUT

- A. Where indicated on the drawings, the Contractor shall have the flexibility in their design to provide the Fire Alarm Power Supplies.
- B. Provide all quantities of equipment as specified, while maintaining the “Spare Capacity” requirements listed elsewhere within this specification.
- C. Coordinate the exact location with the Engineer, prior to installation.

2.11 SYSTEM DEVICE NAMING MATRIX

- A. Provide a Fire Alarm System Device Naming Matrix on the shop drawings for this project
- B. The Device Naming Matrix shall identify the nomenclature used on the shop drawing and shall identify the following:
 - 1. Circuit Type
 - 2. Circuit Number
 - 3. Device Type
 - 4. Device Number

2.12 SYSTEM CABLES, CONNECTORS, AND PATCH CORDS

- A. Include the “Spare Capacity” requirements listed elsewhere within this specification, for the calculations and sizing requirements of the cables and/or conductors.
- B. Cables/Conductors: The minimum allowable size conductors are specified below. Use larger conductors and/or additional conductors, as required. Prior to Bidding, consult with the system Manufacturer that the following cable types are acceptable. It shall be the Contractor’s responsibility to provide and install Manufacturer approved cables. Use the Manufacturers equivalent cable requirements, to meet all code requirements [such as “Wet Rated” or “Aerial Rated” cable] for the appropriate devices.

1. For Fire Alarm System Cable(s):
 - a. Use the Manufacturer recommended cables, or approved equal.

C. See PART 3 of this specification for additional information.

2.13 RECERTIFICATION OF SYSTEM

- A. The Recertification of the System shall be included in the Contractor's Base Bid and the work performed within the warranty period shall be provided at no additional cost to the Port.

2.14 EXTENDED WARRANTY

- A. The following items shall be included in the Base Bid and the work performed within the warranty period shall be provided at no additional cost to the Port.
- B. The warranty period shall be no less than (3) years from the date that the warranty begins.
- C. The warranty shall include, but not be limited to, the following items:
 1. Provide no less than (1) software upgrade and (1) firmware upgrade per year.
 2. Include labor, material, mark up, OH& P for any equipment failure within the above stated timeframe.

2.15 TEST FORMS

- A. The Contractor shall fill out the NFPA 72 "Inspection and Testing Form" during the course of testing the Fire Alarm System. This information shall be provided with the "As-Built" documentation listed elsewhere in this specification.

2.16 TRAINING MATERIALS AND PROGRAMMING SURVEY

- A. EACH of the documents shall have the following:
 1. List the Name or Title of the document, the Section Number, and Section Title. This shall be bold and centered at the top.
 2. Header of document:
 - a. The Project Name and the current date.
 3. Footer of document:
 - a. Use multiple pages as required, but identify each page by having the footer state "Page 1 of X", "Page 2 of X", etc.
 - b. Interview the Port – The Contractor is NOT required to Interview the Port to determine the programming requirements of the system.
 - c. Include with Submittals and Shop Drawings the following documents to the Engineer for review:
 4. A Training Syllabus titled "Section 28 31 00.01 Fire Alarm System – Training Syllabus". This shall include, but not be limited, to the items identified in the "Training Manual".
 - a. Training Manuals for the Site Staff:
 - 1) At The Training Session, Prior To Starting, Provide A Quantity Of Up To Ten (10) Training Manuals To The Site Staff.
 - 2) EACH Training Manual shall be specific to the Site (i.e. Binder Spine, Binder Cover Insert, and the Binders internal documents).

- 3) Each of The Training Manuals Shall Be In A 3-Ring “D” Style Binder. The Binder Shall Be Sized To Allow For 20% Additional Documentation. The Spine Of The Binder Shall Have A Clear Cover With An Insert Clearly Typed With The Following Label “Section 28 31 00.01 Fire Alarm System – (Site Name Here) Training Manual”. The Binder Shall Have A Clear Front Cover With An Insert Clearly Typed With The Title Of The Spine On The Front Sheet, Located At The Top Of The Page, And Centered. Under The Title Of The Spine, The Following Information Shall Also Be Included On The Front Sheet Of The Binder; The Site Name And Site Address, The Project Name And Project Address, The Current Date, The Contractor’s Name, Address, Contact Name And Phone. Each Binder Shall Include The following:
 - (a) Use color coded numbered tabs to separate each item defined below and for each device that was installed. Provide these items in the following order.
- 4) Provide An 8½” X 11” Clear Heavy Plastic Sheet In Front Of A Table Of Contents Page As The First Page Of The Binder Indicating Each Of The Equipment Or Device Documents Contained In Each Tab Section.
- 5) “283100 Fire Alarm System – (Site Name Here) Training Syllabus”.
- 6) Provide the power point presentation actual screen shots of typical functions that are specifically intended to demonstrate the aspects of the Port’s new system. These shall be step-by-step instructions of the most common features that are used on the software. This includes, but Is not limited to:
 - (a) How to acknowledge and silence an “Alarm” condition.
 - (b) How to acknowledge and silence a “Trouble” condition.
 - (c) How to acknowledge and silence a “Supervisory” condition.
 - (d) How to operate the “drill” feature.
 - (e) What to do when there is a “dirty detector” alerts.
 - (f) What to do when there is a loss of dialer communication alert.
 - (g) How and when to call for help from the Ports Maintenance/Contractor.
- 7) Include Color copies of EACH slide that was presented in the power point presentation. Provide a maximum of three (3) legible slides per page, with lines beside each slide to write notes.
- 8) Include the Manufacturers Software Users Manual(s).

PART 3 - EXECUTION

3.01 INSTALLATION

- A. T-Tapping of Notification device conductors is NOT acceptable.

3.02 WIRING

- A. All wiring shall be contained in metal raceways. Wiring insulation shall be one of the types required by NEC 725-16 and shall be consistently color coded throughout the system.
- B. Permanent wire markers shall be affixed to all conductors at terminations and splices. Numbering system shall be consistent with shop drawings.

- C. All terminations shall be T & B "Sta-Kon" (or equivalent) self-insulated, flanged or forked tongue lugs where connected at screw type terminals. Wiring in main control cabinet shall be neatly arranged and bundled with wire ties (or equivalent).
- D. Install wiring equipment in strict accordance with manufacturer's instructions. No wire other than the detector circuit shall be permitted in conduit feeding detectors unless approved.
- E. Minimum wire size for 120 VAC wiring shall be #12 THHN.
- F. Minimum wire size for initiating alarm circuit, i.e., pull stations, heat and smoke detectors, shall be minimum #16 twisted shielded pair FPL rated.
- G. Minimum wire size for speaker and indicating circuits, i.e., horns, strobes, shall be minimum #16 shielded, twisted FPL rated cable. Indicating circuits shall be sized in accordance with manufacturer recommended voltage drop requirements, minimum size #14 AWG.
- H. Provide separate raceway or shielded cable as required or recommended by system manufacturer to prevent the introduction of noise into the system.
- I. All junction boxes for fire alarm shall be red and labeled in minimum ¼" letters: FIRE ALARM.
- J. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits, signaling line circuits, and notification appliance circuits.
- K. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
- L. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
- M. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
- N. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.
- O. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.
- P. Connections to the communicator will be made by the Fire Alarm Vendor, in the presence of the Electrical Contractor, 1-week prior to the final acceptance test with the AHJ.
- Q. All circuits shall be identified in accordance with table 3.02L with labels to include wire type, quantity and circuit number. Wire code shall match AHJ approved shop drawings wire code. Labels must be provided at the FACP and all junction boxes. Labels shall be produced using an electronic labeler.

Table 3.03 R

Example: C2HX3

C = Signal Circuit Wire

2 = Signal circuit number

H = Annunciator wire

X = Addressable initiating device circuit wire

3 = Addressable initiating device circuit number

3.03 CONDUIT

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. All wiring in exposed areas shall be installed in conduit or raceway.
3. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
4. Wiremold fill shall not exceed 40% of the interior cross sectional area.
5. It is permissible to install fire alarm low voltage cables open in D rings above accessible ceilings.
6. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760.
7. Wiring for 24 volt control, alarm notification, and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
8. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
9. Conduit shall be 3/4 inch (19.1 mm) minimum.

3.04 WIREMOLD SURFACE RACEWAY

- A. Wiremold Surface Raceway shall be meet the requirements of Underwriters Laboratories Inc. and conform to U.S. Federal Specification W-C-582.
- B. Wiremold Surface Raceway shall be in accordance with N.F.P.A. #70, local requirements, and state requirements.
- C. Wiremold Surface Raceway shall be constructed of steel with a minimum thickness of 0.040".
- D. Wiremold Surface Raceway shall have the following features:
 1. Rugged steel raceway.
 2. Low-profile and unobtrusive appearance.
 3. Base and cover are preassembled as a one-piece unit.
 4. Surface mounting.
 5. Full line of fittings.
 6. Fittings have removable covers.
 7. UL #5 "Standard for Surface Metal Raceways and Fittings" and ADA compliant.

3.05 MOUNTING HEIGHTS, LOCATIONS, AND SETTINGS

- A. Prior to rough-in, coordinate with the Engineer for the exact location(s). Install all devices and/or equipment per the manufacturer's recommendation.
- B. Fire Alarm Control Panel (FACP):
 - 1. The Fire Alarm Control Panel shall be installed in the location indicated on the contract documents.
 - 2. The Fire Alarm Control Panel shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
 - 3. The top of the Fire Alarm Control Panel shall be located 60" above the finished floor, unless noted otherwise and shall be installed level.
- C. Fire Alarm Remote Annunciator Panel (FARAP):
 - 1. Provide flush mounted Fire Alarm Remote Annunciator Panel(s) when located in finished areas or where indicated on the contract documents.
 - 2. Provide surface mounted Fire Alarm Remote Annunciator Panel(s) when located in unfinished areas or where indicated on the contract documents.
 - 3. The top of the Fire Alarm Remote Annunciator Panel(s) (FARAP) shall be located 48" above the finished floor, unless noted otherwise and shall be installed level.
 - 4. The maximum length of cabling between the Fire Alarm Control Panel and the Fire Alarm Remote Annunciator Panel(s) shall be limited to 6,000 feet.
- D. Addressable Manual Stations: The manual pull station(s) shall connect to one of the fire alarm control panel signaling line circuit (SLC) loops.
 - 1. EACH manual pull station shall be mounted 48" above the finished floor, and be located within 5'-0" of the door. For the following equipment, provide quantities as required.
- E. Addressable Smoke Detectors: The smoke detectors shall connect to one of the fire alarm control panel signaling line circuit (SLC) loops.
 - 1. Locate detectors not less than two (2) feet from a supply or exhaust ventilation grille.
- F. Addressable Control Module: The control module shall connect to one of the fire alarm control panel signaling line circuit (SLC) loops.
 - 1. Audio-visual and/or 24vdc power shall be provided by a separate loop from the main control panel or from supervised remote Fire Alarm Power Supplies (FAPS)'s.
 - 2. The monitor module shall mount in a 4-inch square, 2-1/8" deep electrical box, to a surface mounted back box, or directly into the fire alarm control panel.
- G. Graphic Maps:
 - 1. Provide a full color graphical representation of the floor plan(s) that shall be installed directly adjacent to each Fire Alarm Remote Annunciator Panel and by the Fire Alarm System Control Panel.
 - 2. Graphic Maps shall be a minimum of 11"x17" in size, but shall be based upon the actual building footprint with all text being at a 1/8" scale.
 - 3. Graphic Maps shall include the following information at a minimum:
 - a. Building Name(s) (and numbers where applicable).

- b. Room Names and Numbers.
 - c. Doors.
 - d. Location of the Fire Alarm Remote Annunciator Panel.
 - e. Location of the Fire Alarm System Control Panel.
 - f. A "You Are Here" with an arrow pointing at the wall or area location of where Graphic Map is to be installed.
 - g. Show the connections and system(s) being monitored by the Fire Alarm System.
 - h. Provide a System Legend at the top of each Graphic Map indicating the following applicable systems:
 - 1) Fire Protection Sprinkler System Post Indicator Valve(s)
 - 2) Fire Protection System Water Flow Switch(s)
 - 3) Fire Protection System Tamper Switch(s)
 - 4) Fire Protection Sprinkler System Pressure Switch(s)
 - 5) Fire extinguisher cabinets
 - 6) Other systems that would typically interface to the Fire Alarm System.
 - i. "North" arrow
 - j. Provide the image/logo and name of the Port at the top of each Graphic Map.
4. Each Graphic Map shall identify the following areas by a separate pastel Color:
- a. Administrative Areas
 - b. Class Rooms
 - c. Hallways and Commons
 - d. Gymnasium(s) and Multi-Purpose Room(s)
 - e. Kitchens
 - f. Cafeteria
 - g. Restrooms
 - h. Portables
5. The room numbering system depicted on each Graphic Map shall match that of the final signage and room identification system adopted by the Port.
6. For multi-story buildings:
- a. The bottom of each Graphic Map shall be the lowest level of the building.
 - b. The top of each Graphic Map shall be the highest level of the building.
7. Graphic Maps shall be secured in a black anodized aluminum frame, have Tempered Glass to protect the graphic image, and be mounted with a concealed security hanging system.
8. Graphic Maps installed on the interior of the building shall consist of the following:
- a. Printed on the reverse side of 10 mil polycarbonate Lexan.

- b. Standard background shall be white.
 - c. The Lexan image shall mount to a rigid 1/8" substrate with removable adhesive mounts.
 - d. The Graphic Map shall be secured to a black anodized aluminum frame.
 - e. Provide Graphic Map with a concealed security hanging system to prevent unauthorized removal.
9. Graphic Maps installed on the exterior of the building shall consist of the following:
- a. Printed on 1/8" silver brushed aluminum, white aluminum, or stainless steel.
 - b. The Graphic Map shall be designed to attached to an exterior wall by a screw located in each of the four corners.
- H. Horn/Strobe and Strobe Only:
- 1. Install Synchronization modules and/or equipment as recommended by the manufacturer to meet all code requirements as required.
 - 2. Ceiling Mount Applications:
 - a. The Notification device shall be ceiling mounted as recommended by the manufacturer.
 - 3. Wall Mount Applications:
 - a. Indoor Mounting; shall be at 80" above the finished floor (a.f.f.) or 6" below the ceiling, whichever is lower, and as recommended by the manufacturer.
 - b. Outdoor and/or Weatherproof Mounting:
 - 1) Mount at the height as indicated on the drawings. If a mounting height is not shown, coordinate with the Engineer for the exact location.
 - 2) Install weatherproof back box and/or weatherproof sealant per the manufacturer's recommendation to mount and prevent moisture from entering the structure.

3.06 PROGRAMMING AND CONFIGURATION

- A. Program the FACP as required for a fully functional system, and as defined throughout this specification, as required by Code, and as required by the AHJ.
- B. Program the FACP Dialer.
 - 1. Activate the built-in digital communicator, seize the protected premises telephone line, and automatically report the alarm point/device information to the remote monitoring agency.

3.07 WIRING

- A. All wiring shall be contained in metal raceways. Wiring insulation shall be one of the types required by NEC 725-16 and shall be consistently color coded throughout the system.
- B. Permanent wire markers shall be affixed to all conductors at terminations and splices. Numbering system shall be consistent with shop drawings.
- C. All terminations shall be T & B "Sta-Kon" (or equivalent) self-insulated, flanged or forked tongue lugs where connected at screw type terminals. Wiring in main control cabinet shall be neatly arranged and bundled with wire ties (or equivalent).

- D. Install wiring equipment in strict accordance with manufacturer's instructions. No wire other than the detector circuit shall be permitted in conduit feeding detectors unless approved.
- E. Minimum wire size for 120 VAC wiring shall be #12 THHN.
- F. Minimum wire size for initiating alarm circuit, i.e., pull stations, heat and smoke detectors, shall be minimum #16 twisted shielded pair FPL rated.
- G. Minimum wire size for speaker and indicating circuits, i.e., horns, strobes, shall be minimum #16 shielded, twisted FPL rated cable. Indicating circuits shall be sized in accordance with manufacturer recommended voltage drop requirements, minimum size #14 AWG.
- H. Provide separate raceway or shielded cable as required or recommended by system manufacturer to prevent the introduction of noise into the system.
- I. All junction boxes for fire alarm shall be red and labeled in minimum ¼" letters: FIRE ALARM.
- J. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits, signaling line circuits, and notification appliance circuits.
- K. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
- L. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
- M. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.
- N. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.
- O. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.
- P. Connections to the communicator will be made by the Fire Alarm Vendor, in the presence of the Electrical Contractor, 1-week prior to the final acceptance test with the AHJ.
- Q. All circuits shall be identified in accordance with table 3.02L with labels to include wire type, quantity and circuit number. Wire code shall match AHJ approved shop drawings wire code. Labels must be provided at the FACP and all junction boxes. Labels shall be produced using an electronic labeler.

Table 3.03 R

Example: C2HX3

C = Signal Circuit Wire

2 = Signal circuit number

H = Annunciator wire

X = Addressable initiating device circuit wire

3 = Addressable initiating device circuit number

3.08 ADDITIONAL FIELD DEVICES AND INSTALLATION LABOR

- A. In order to minimize the schedule and cost impact of implementing minor changes during the course of construction, the following list of material and installation labor shall be included in this scope of work. The Contractor shall include in his bid the listed materials, labor that is based on existing jobsite conditions and established construction standards, and all fees associated with documenting and executing these changes. The locations of additional field devices shall be as directed by the Engineer.
- B. The material included but is not limited to:

<u>QTY</u>	<u>ITEM</u>
1	Photo Electric Smoke Detector/Base
2	Manual Pull Stations
4	Horn/Strobe Units
24	Device Boxes
24	4S J-boxes with blank covers
500 LF etc.)	½" EMT with 4-#14 THHN wire (includes couplers, straps, connectors,
50 Hrs.	Labor for Journeyman Electrician
1 Lot	Miscellaneous fees, tools, material, handling, O H & P

- C. Fire Alarm devices that are not installed under this section are property of the Port and shall be turned over to the Port's representative at the end of this project.
- D. Provide proof of delivery with the as-built documentation.

3.09 OPERATION AND MAINTENANCE MANUALS

- A. The manuals shall include a complete materials list of the fire alarm system including the addresses and phone numbers of local sources of replacement parts.

3.10 FORMAL TESTS AND INSPECTIONS

- A. Do not submit a request for formal test and inspection until the preliminary test and corrections are completed and approved.
- B. Submit a written request to local fire protection authority for formal inspection at least 15 days before the inspection date.
- C. An experienced technician regularly employed by the system installer shall be present during the inspection.
- D. At this inspection, repeat any or all of the required tests as directed.
- E. Correct defects in work provided by the Contractor and make additional tests until the system(s) comply with contract requirements.
- F. Furnish appliances, equipment, electricity, instruments, connecting devices and personnel for the tests.
- G. At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.
- H. Furnish Engineer with certificates required by testing agencies.

3.11 FIRE ALARM TESTING & SYSTEM FUNCTIONALITY

- A. Upon completion of the new system installation, the Contractor shall conduct a system test for the Port, Engineer, and Authority Having Jurisdiction (Fire Marshal) or their appointed representatives to verify operation of the system.
- B. This test shall be conducted by a factory trained equipment manufacturers representative and verify to those present satisfactory operation of the system.
- C. The Contractor shall provide two-way communication devices for their own staff, each Port's Representative, and the Engineer, so that all parties can communicate as required to perform all tests.
- D. The Fire Alarm System shall meet all of the requirements and completely fill out all applicable documents contained Section 7.8 "Forms" in the 2013 Edition of N.F.P.A. #72.
- E. The Fire Alarm System shall be installed, fully functional, tested, and accepted by the Authority Having Jurisdiction, prior to acceptance from the Engineer.
- F. After completion of the test/demonstration, the Contractor shall obtain written approval on an accepted form from the AHJ that the system is approved.
- G. If the Fire Alarm System contractor fails the Fire Marshal Inspection, the following shall occur:
 - 1. The Fire Alarm System contractor shall make all of the necessary corrections as required, to pass the Authority Having Jurisdiction testing and inspection.
 - 2. Notify the Authority Having Jurisdiction and schedule another test.
 - 3. Continue making corrections until the Fire Alarm System has been accepted by the Authority Having Jurisdiction.
- H. After acceptance of the system testing, the Contractor shall obtain written approval on an acceptance form from the Authority Having Jurisdiction indicating that the system is approved and shall submit a copy of approved acceptance form along with a letter containing the following statement:
 - 1. "The undersigned, having been engaged as the Contractor for the BUILDING OWNER confirms that the Fire Alarm equipment was installed in accordance with the plans and specifications, and in accordance with the wiring diagrams and directions provided to us by the manufacturer, and that all wire installed is approved for "Power Limited" fire alarm use under Article 760 of the National Electrical Code. It has been completely tested and demonstrated to the Engineer, and accepted by the Code Enforcing Authority Having Jurisdiction".

3.12 TESTING REQUIREMENTS

- A. Fire Alarm Control Panel:
 - 1. Verify Fire Alarm Control Panel LED's.
 - 2. Verify Fire Alarm Control Panel Display.
 - 3. Verify Fire Alarm Control Panel Piezo electric signal operates.
 - 4. Verify Fire Alarm Control Panel Alarm Condition.
 - 5. Verify Fire Alarm Control Panel Trouble Condition.
 - 6. Verify Fire Alarm Control Panel Supervisory Condition.
 - 7. Verify Fire Alarm Control Panel Monitor Condition.

8. Verify Fire Alarm Control Panel Alarm Silence Switch.
 9. Verify Fire Alarm Control Panel Queue Switch.
 10. Verify Fire Alarm Control Panel Reset Switch.
 11. Verify Fire Alarm Control Panel AC Power Failure.
 12. Verify Fire Alarm Control Panel Battery Trouble.
 13. Verify Fire Alarm Control Panel Battery Charger.
 14. Verify Fire Alarm Control Panel Battery Back-up Test.
 15. Verify Fire Alarm Control Panel Ground Fault.
 16. Verify Fire Alarm Control Panel Open Circuit.
 17. Verify Fire Alarm Control Panel Short Circuit.
 18. Verify Fire Alarm Control Panel readout matches the address and location of all field devices.
- B. Fire Alarm / Booster Power Supplies:
1. Verify Fire Alarm Extender / Booster Power Supply AC Power Failure.
 2. Verify Fire Alarm Extender / Booster Power Supply Battery Trouble.
 3. Verify Fire Alarm Extender / Booster Power Supply Battery Charger.
 4. Verify Fire Alarm Extender / Booster Power Supply Battery Back-up Test.
 5. Verify Fire Alarm Extender / Booster Power Supply Ground Fault.
 6. Verify Fire Alarm Extender / Booster Power Supply Open Circuit.
 7. Verify Fire Alarm Extender / Booster Power Supply Short Circuit.
- C. Fire Alarm Initiating Devices:
1. Verify activation of all Manual Pull Stations initiates a building Alarm condition.
 2. Verify activation of all System Smoke Detectors initiate a building Alarm condition.
- D. Fire Alarm Notification Appliances:
1. Verify that all horns are operational.
 2. Verify that all clear strobes are operational and synchronized.
- E. Initiating Device Circuit (IDC), Signal Line Circuit (SLC), and notification Appliance Circuit (NAC) wiring:
1. Megger testing of all circuits.
 2. Loop Resistance test.
 3. Verify Open Circuit condition in all circuits.
 4. Verify Open Circuit Ground condition in all circuits.
 5. Verify Open Circuit Wire to Wire Short condition in all circuits.
 6. Verify Closed Circuit Ground Fault condition in all circuits.
 7. Verify Closed Circuit Wire to Wire Short condition in all circuits.

8. Verify Closed Circuit Wire to Wire Short and Ground condition in all circuits.
9. Verify Circuit Voltage of each circuit at maximum system operation.
10. Verify Current Draw of each circuit at maximum system operation.

3.13 AUDIBILITY REQUIREMENTS

- A. Decibel readings shall be taken at a point 10'-0" from the appliance at an elevation of 5'-0" above finished floor.
- B. The sound level shall be at least 15 decibel (dB) above average ambient sound level of 5 dB above the maximum sound level and having a duration of at least 60 seconds.
- C. Decibel measurements shall be taken using the "A-weighted" measurements which are relatively flat from 600 Hz to 7,000 Hz, "B-weighted" (relatively flat from 300 Hz to 4,000 Hz) and "C-weighted" (relatively flat from 700 Hz to 4,000 Hz, measurements will not be acceptable.

3.14 INSTRUCTION AND TRAINING PERIOD

- A. Upon completion of the work and after all tests and inspections by the authority(s) having jurisdiction, the Contractor shall "Hands On" demonstrate and train the Port's designated operation and maintenance personnel in the operation and maintenance of the Fire Alarm system.
- B. The Fire Alarm System Contractor shall submit Operations and Maintenance Manuals to the Engineer to review prior to scheduling the instruction session.
- C. The Contractor shall provide a typewritten "Sequence of Operations".
- D. The Contractor shall arrange scheduled instruction periods with the Port's designated operation and maintenance personnel.
- E. The Contractor's representatives shall be superintendents or foremen who are knowledgeable in each system and suppliers representatives when so specified.
- F. The Contractor shall provide for (1) editing session of the control panel programming at no cost to the Port to address any changes required by the Engineer.
- G. Scheduled training periods shall be based upon complexity of the system installed, but in no case be less than 4 hours.
- H. Upon request of the Engineer, a DVD of the training period shall be made available by the Fire Protection Contractor at no additional cost to the Port.

3.15 SPARE PARTS

- A. The following list of materials shall be delivered to the Engineer upon completion of the final testing and system certifications:

<u>QTY</u>	<u>Item</u>
3	Addressable Smoke Detector
3	Addressable Smoke/Heat Detector Bases
2	Addressable Control Modules
2	Addressable Monitor Modules
3	Horn/Strobes

- B. All spare parts shall be identical to those provided for this project.
- C. Provide the Spare Parts Proof of Delivery Form with the As-built documentation.

3.16 AS-BUILTS

- A. Provide all As-Built documentation as defined in Section 27 00 00 Low Voltage Systems General Requirements and listed elsewhere in this specification.
- B. The Contractor shall provide the NFPA 72 "Inspection and Testing Form" filled out during the course of testing the Fire Alarm System.
- C. Update all documents provided in the Submittal and Shop Drawings to accurately reflect the actual equipment that was provided for this project, and the actual locations of the installed equipment.
- D. The Contractor shall include in the pricing of their bid, the time and materials to generate and create the documentation, as described below.
 - 1. Provide an "Equipment Information Sheet", in the O & M manuals. At a minimum, from left to right, provide the following information;
 - a. Each row shall have an "Item #".
 - b. Manufacturers Name.
 - c. Equipment Device Type (such as Workstation, Control Panel, etc).
 - d. Location (such as MDF room 103, or area of building).
 - e. IP Address.
 - f. Software Name.
 - g. Software Version that is installed on the device.
 - h. List the "Highest Level" configurable password for EACH device.
 - i. List "EACH System Operator" password.
 - j. List all other password settings for EACH device.
- E. Include a "Proof of Delivery Form" that includes, but is not limited to;
 - 1. Documentation:
 - a. The quantities of EACH Binder.
 - b. The Binder Spine Name.

END OF SECTION