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SECTION 015723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.3 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location specified by the Project Engineer.

1. Meet with Owner, Architect, Construction Manager, and earthwork subcontractor.
2. Review requirements of the SWPPP, including permitting process, worker training, and inspection and maintenance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPP): Within 15 days of date established for commencement of the Work, submit completed SWPPP.

B. EPA authorization under the EPA's "2017 Construction General Permit (CGP)."

C. Stormwater Pollution Prevention (SWPP) Training Log: For each individual performing Work under the SWPPP.

D. Inspection reports.

1.6 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

    a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 015723

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Spread Footings.
   2. Foundation walls.

B. Related Sections:
   1. Division 2 Sections for drainage fill under slabs-on-grade, paving, and walks.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Fiber reinforcement.
   6. Waterstops.
   7. Floor and slab treatments.

8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.
13. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Engaged by Owner

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.

d. Concrete subcontractor.
e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

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

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. 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.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type II, gray (in contact with soil); ASTM C 150, Type I/II, gray (elevated slab).
   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
      b. BASF Construction Chemicals - Building Systems; Confilm.
      c. ChemMasters; SprayFilm.
      d. Conspec by Dayton Superior; Aquafilm.
      e. Dayton Superior Corporation; Sure Film (J-74).
      f. Edoco by Dayton Superior; BurkeFilm.
      g. Euclid Chemical Company (The), an RPM company; Eucobar.
      h. Kaufman Products, Inc.; Vapor-Aid.
      i. Lambert Corporation; LAMBCO Skin.
      j. L&M Construction Chemicals, Inc.; E-CON.

k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. 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.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.8 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, 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 5000 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, 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: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 20 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing 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 water-cementitious materials ratio below 0.50.
   4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: per structural drawings.

2. Maximum Water-Cementitious Materials Ratio: per structural drawings.
3. Slump Limit: per structural drawings.
4. Air Content: per structural drawings, plus or minus 1.5 percent at point of delivery.

B. Foundation Walls/Grade beams: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: per structural drawings.
2. Maximum Water-Cementitious Materials Ratio: per structural drawings.
3. Slump Limit: per structural drawings.
4. Air Content: per structural drawings, plus or minus 1.5 percent at point of delivery.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: per structural drawings.
2. Minimum Cementitious Materials Content: per structural drawings.
3. Slump Limit: per structural drawings.
4. Air Content: per structural drawings, plus or minus 1.5 percent at point of delivery.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, 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.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

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

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

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 C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. 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.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
   1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.5 STEEL REINFORCEMENT

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls 60 ft on center. 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.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07920 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. 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.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. 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 or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing.

C. 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. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated, unless special finish concrete is designated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

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.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. 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 the remainder of the 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 will not interfere with bonding of floor covering used on Project.

3.13 LIQUID FLOOR TREATMENTS

A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING

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

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint 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.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing 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 will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch 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 Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

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

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens (6 in. by 12 in.) or two sets of three 4 in. by 8 in. cylinders specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days for standard cylinders. For 4 in. by 8 in. cylinders, test one set of three field-cured specimens at 7 days and one set of three specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated. For 4 in. by 8 in. cylinder, a compressive-strength test shall be the average compressive strength from a set of three specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect/Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

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

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Structural steel.
2. Grout.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Steel Deck" for field installation of shear connectors.
3. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
4. Division 9 painting Sections for surface preparation and priming requirements.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.04 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents.

B. Construction: Type 2, simple framing.

1.05 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.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding certificates.

D. Qualification Data: For Installer fabricator testing agency.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shear stud connectors.
6. Shop primers.
7. Nonshrink grout.

F. Source quality-control test reports.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CASE.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Cbd.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

E. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. 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.

1.08 COORDINATION

A. Furnish 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.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Corrosion-Resisting Structural Steel: ASTM A 588/A 588M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
1. Finish: Black, except where indicated to be galvanized.

H. Medium-Strength Steel Castings: ASTM A 27/A 27M, Grade 65-35, carbon steel.

I. High-Strength Steel Castings: ASTM A 148/A 148M,Grade 80-50, carbon or alloy steel.

J. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.
2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.

a. Finish: Plain.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type, plain.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36 ASTM A 307, Grade A.
1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 hardened carbon steel.
4. Finish: Plain.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 hardened carbon steel.
4. Finish: Plain.

G. Threaded Rods: ASTM A 193/A 193M ASTM A 307, Grade A.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Washers: ASTM F 436 hardened carbon steel.
3. Finish: Plain.

H. Clevises Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

I. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

J. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.03 PRIMER

A. Primer: SSPC-Paint 25, Type I, iron oxide, zinc oxide, raw linseed oil, and alkyd.

B. Galvanizing Repair Paint: ASTM A 780.

2.04 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

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's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. 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.

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 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, cross-recessed head 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 passage of other work 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. Base-Plate 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.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

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.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.

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. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize lintels shelf angles attached to structural-steel frame and located in exterior walls.

2.09 SOURCE QUALITY CONTROL

A. Owner 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.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

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.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
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 base or bearing plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and base or bearing 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 forming 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.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. 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 and manufacturer's written instructions.

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.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    c. Ultrasonic Inspection: ASTM E 164.
    d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION 051200

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Roof Deck.
   2. Noncomposite form deck.

B. Related Sections include the following:
   1. Division 5 Section "Structural Steel" for shop- and field-welded shear connectors.
   2. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   3. Division 9 painting Sections for repair painting of primed deck.

1.03 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. 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. Power-actuated mechanical fasteners.

G. Research/Evaluation Reports: For steel deck.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. 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."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Steel Deck:

a. ASC Profiles, Inc.
b. Canam Steel Corp.;The Canam Manac Group.
c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.
h. New Millennium Building Systems, LLC.
i. Nucor Corp.; Vulcraft Division.
j. Roof Deck, Inc.

k. United Steel Deck, Inc.
l. Valley Joist; Division of EBSCO Industries, Inc.
m. Verco Manufacturing Co.
n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

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. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated

2.03 NONCOMPOSITE FORM DECK

A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

   a. Color: Manufacturer's standard.

2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.
5. Side Laps: Overlapped.

2.04 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

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. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

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 sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Galvanizing Repair Paint: ASTM A 780.

L. 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.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, 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.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

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 (38 mm) long, and as indicated on the drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, as indicated on the drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

E. 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: 5/8 inch, nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
3. Weld Spacing: Space and locate welds as indicated.
4. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

3. Fasten with a minimum of 1-1/2-inch- long welds.

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.

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. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on top surface 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 of bottom deck surfaces are included in Division 9 Section "."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9 Section "."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Exterior and interior non-load-bearing wall framing.
   2. Ceiling joist framing.

B. Related Sections include the following:
   1. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   2. Division 9 Section "Gypsum Board Shaft-Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.03 SUBMITTALS

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

B. Shop Drawings (NON-engineered): Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Welding certificates.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

E. Research/Evaluation Reports: For cold-formed metal framing.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

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

D. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Comply with AISI's "Standard for Cold-Formed Steel Framing."

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.05 DELIVERY, STORAGE, AND HANDLING

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

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:

1. Allied Studco.
2. AllSteel Products, Inc.
3. California Expanded Metal Products Company.
4. Clark Steel Framing.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.
9. Design Shapes in Steel.
10. Dietrich Metal Framing; a Worthington Industries Company.
11. Formetal Co. Inc. (The).
12. Innovative Steel Systems.
13. MarinoWare; a division of Ware Industries.
14. Quail Run Building Materials, Inc.
15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.
18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.02 MATERIALS

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

1. Grade: As required by structural performance.
2. Coating: G60, A60, AZ50, or GF30.

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING

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

1. Minimum Base-Metal Thickness: as indicated on drawings.
2. Flange Width: 1-5/8 inches.

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

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Dietrich Metal Framing; a Worthington Industries Company.
    b. MarinoWare, a division of Ware Industries.
    c. SCAFCO Corporation
    d. The Steel Network, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Minimum Base-Metal Thickness: as indicated on drawings.
3. Flange Width: 1 inch plus the design gap for 1-story structures and 1 inch plus twice the design gap for other applications.

2.04 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-5/8 inches, minimum.

2.05 FRAMING ACCESSORIES

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

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.

10. Hole reinforcing plates.
11. Backer plates.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. 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 per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

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

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 FABRICATION

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

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-

resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls **or** warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing infill studs and anchor to building structure.
4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Drawings. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

a. Install solid blocking at centers indicated.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.05 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.06 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Windscreen supports.

B. Products furnished, but not installed, under this Section include the following:
1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 COORDINATION

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

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors.
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.

C. Samples for Verification: For each type and finish of extruded nosing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with 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/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 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, ambient; 180 deg F, material surfaces.

2.2 METALS

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.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum and stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: 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 in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

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

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: For interior items not indicated to receive paint: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

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

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are 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.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 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 recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by

partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

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

2.8 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. 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.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, 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 come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF 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 overhead doors securely to, and rigidly brace from, building structure.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking.
2. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 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

2.1 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. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall 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 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 blocking.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
3. Eastern softwoods, No. 2 Common grade; NELMA.
4. Northern species, No. 2 Common grade; NLGA.

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 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.

2.5 PLYWOOD BACKING PANELS

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

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where 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 A153/A153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954 as applicable, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Material: For exterior and wet areas: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. 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.

D. Provide blocking and framing as indicated 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 o.c.

E. Sort and select lumber so that natural characteristics do 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.

F. 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.

G. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

H. 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.

3.2 WOOD BLOCKING INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 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 miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.

1.2 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.

1.3 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.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc.
b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
d. USG Corporation; Securock.

2. Type and Thickness: Regular, 1/2 inch thick.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329-inch-thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112-inch-thick, use screws that comply with ASTM C954.

PART 3 - EXECUTION

3.1 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. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate wall 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.

E. Cut and space edges of panels to match spacing of structural support elements.

F. 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.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

    a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermoset Decorative Panels: 8 by 10 inches, for each color, pattern, and surface finish.

    a. Provide edge banding on one edge.

3. Corner Pieces:

a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
b. Miter joints for standing trim.

4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: 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. Installer Qualifications: Manufacturer of products.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the ANSI/AWI 0641 – Architectural Wood Casework Standard, which replaces Section 10 of the 2014 edition of Architectural

Woodwork Standards, for grades of architectural cabinets indicated for construction, finishes, installation, and other requirements.

B. ANSI/AWI 0641 Aesthetic Grade: Custom.

C. ANSI/AWI 0641 Duty Level: 3.

D. Type of Construction: Frameless.

E. Door and Drawer-Front Style: Flush overlay.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product with color match acceptable to Architect by one of the following:

a. Formica Corporation.
b. Lamin-Art, Inc.
c. Wilsonart LLC.

G. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.

2. Vertical Surfaces: Grade HGS.
3. Edges: ABS edge banding, 0.12-inch thick, matching laminate in color, pattern, and finish.
4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

H. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: ABS edge banding, 0.12-inch thick, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: ABS edge banding.
c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.

2. Drawer Sides and Backs: Thermoset decorative panels with ABS edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
2. Match Architect's sample.
3. As selected by Architect from laminate manufacturer's full range in the following categories:

    a. Patterns, matte finish.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Particleboard: ANSI A208.1, Grade M-2 or M-3; Grade M-2-Exterior Glue at sink bases.

2. Softwood Plywood: DOC PS 1, void-free core.
3. Thermoset Decorative Panels: Particleboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

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

    a. Accuride International.
    b. Blum, Julius & Co., Inc.
    c. Grass America Inc.
    d. Knape & Vogt Manufacturing Company.

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

F. Catches: Roller catches, BHMA A156.9, B03071.

G. Shelf Rests: BHMA A156.9, B04013; two-pin plastic with shelf hold-down clip.

H. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

a. Type: Full extension.
b. Material: Zinc-plated or epoxy-coated steel with polymer or steel rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-overtravel-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

I. Door Locks: BHMA A156.11, E07121.

J. Drawer Locks: BHMA A156.11, E07041.

K. Door and Drawer Silencers: BHMA A156.16, L03011.

L. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As selected by Architect from manufacturer's standard colors.

M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
3. Satin Stainless Steel: BHMA 630.

N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: PVA.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

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

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

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

2. Install cabinets without distortion so doors and drawers' fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket.

B. Related Requirements:

1. Division 07 roofing section(s) for insulation specified as part of roofing construction.
2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. CertainTeed.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.

2.2 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

3.4 Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.5 PROTECTION

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

END OF SECTION

SECTION 072616 – UNDER-SLAB VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vapor retarder sheet for under-slab installations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained by manufacturer and experienced in installing Work of this Section.

PART 2 - PRODUCTS

2.1 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fortifiber Building Systems Group; Moistop Ultra 15.
    b. Raven Industries, Inc; VaporBlock VB15.
    c. Reef Industries, Inc; Griffolyn 15 Mil.
    d. Stego Industries, LLC; Stego Wrap Vapor Barrier (15-Mil).
    e. W.R. Meadows, Inc; Perminator 15 mil.

2.2 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by vapor retarder manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
2. Seam Tape and Mastic: Manufacturer's recommended products forming permanent bond with sheet vapor retarder.
3. Flashing Boots: Manufacturer's recommended products configured for sealing around pipe and conduit penetrations of below-grade vapor retarder sheet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting installation and performance of vapor retarder.

3.2 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. Install sheet vapor retarder with longest dimension parallel to planned direction of concrete placement.
2. Lap joints 6 inches and seal with manufacturer's recommended tape and mastic material.
3. Extend and lap vapor barrier over footings and up and over intervening foundation construction and make positive, air- and moisture- tight interface with adjacent wall vapor barrier, utilizing sheet goods or compatible mastic application recommended by manufacturer. Comply with detail requirements indicated on Drawings.
4. Seal penetrations in sheet vapor retarder, including pipe and conduit, in accordance with manufacturer’s instructions. Permanently seal open ends of pipe or conduit used as supports and to remain concealed within walls.

3.3 PROTECTION AND REPAIR

A. Do not permit activity on installed vapor retarder that may result in puncturing of sheet.

B. Protect installed vapor retarder 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 vapor retarder that does not comply with requirements; repair substrates, reinstall vapor retarder, and seal seams and penetrations.

END OF SECTION

SECTION 072715 - SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-adhering, vapor-permeable, nonbituminous sheet air barriers.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.2 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil-thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side.

1. Products: Subject to compliance with requirements, provide one of the following:

a. G.C. P. (formerly Grace Construction Products); Perma-a-Barrier VPS 30.
b. Henry Company; Blueskin VP 160.
c. Tremco; ExoAir 210AT.
d. VaproShield; WrapShield SA.
e. W.R. Meadows; Air-Shield SMP

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E2178.
b. Puncture Resistance: Minimum. 40 lbf; ASTM E154/E154M.
c. Vapor Permeance: Minimum 15 perms; ASTM E96/E96M, Desiccant Method, Procedure A.
d. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D4541 as modified by ABAA.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

PART 3 - EXECUTION

3.1 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 substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

D. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

E. Bridge discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic.

C. If primer is recommended by membrane manufacturer for substrate, apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

G. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

H. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, exterior glazing and window systems, glazed curtain-wall systems, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

I. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

J. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

K. Wall Openings: Prime concealed, perimeter frame surfaces of curtain walls, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

L. Fill gaps in perimeter frame surfaces of curtain walls, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

M. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

N. Do not cover air barrier until it has been tested and inspected by testing agency.

O. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Site conditions for application temperature and dryness of substrates have been maintained.
4. Maximum exposure time of materials to UV deterioration has not been exceeded.
5. Surfaces have been primed.
6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
7. Termination mastic has been applied on cut edges.
8. Air barrier has been firmly adhered to substrate.
9. Compatible materials have been used.
10. Transitions at changes in direction and structural support at gaps have been provided.
11. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
12. All penetrations have been sealed.

B. Tests: As determined by testing agency from among the following tests:

1. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
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 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 structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

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

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

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 roof area and eave, including fascia, as shown on Drawings; including attachments, underlayment, and accessories.
2. Build mockups for typical roof area only, including accessories.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems 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: Two 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 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 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. 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, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips inside laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis of Design: Subject to compliance with requirements, provide Atas International, Inc, Curved 1” Field-lok or comparable product by one of the following:

a. Berridge.
b. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch.

b. Surface: Smooth, flat finish.
c. Exterior Finish: Two-coat fluoropolymer.
d. Color: As selected by Architect from manufacturer's full range.

3. Clips: Two-piece floating to accommodate thermal movement.

a. Material: 0.064-inch-nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
b. Material: 0.0625-inch-thick, stainless-steel sheet.

4. Joint Type: Double folded.
5. Panel Coverage: 16 inches 18 inches.
6. Panel Height: 2.0 inches 2.5 inches.

2.3 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, coated glass fiber facer on both major surfaces, minimum R-6 per inch thickness.

1. Compressive Strength: 20 psi.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

a. **Carlisle WIP Products; a brand of Carlisle Construction Materials**; WIP 300HT.
b. **GCP Applied Technologies Inc**.; Grace Ice and Water Shield HT.
c. **Henry Company**; Blueskin PE200 HT.
d. **Protecto Wrap Company**; Protecto Jiffy Seal Ice & Water Guard HT.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application, if required by metal panel manufacturer.

2.5 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal 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-thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

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-wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.6 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, 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. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to 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 Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

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

2.7 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. 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.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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 for seacoast and severe environments.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal roof panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

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

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: 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 panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. 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 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 achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal composite material wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material 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 composite material 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 affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

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

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems 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: Two 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 composite material 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 D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. 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, ambient; 180 deg F, material surfaces.

E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

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

1. 3A Composites; Alucobond.
2. Alpolic.
3. Arconic Architectural Products; Reynobond.
4. Centria.

C. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 4 mm.
2. Core: Fire retardant.
3. Exterior Finish: Two-coat fluoropolymer.

a. Color: As indicated by manufacturer's designations.

D. Attachment Assembly Components: Formed from extruded aluminum.

E. Attachment Assembly: Manufacturer's standard Clip.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels 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 composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, 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 composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to 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 Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal 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.

2.5 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material 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 composite material wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.

2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

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

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.

F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.

1. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

G. Accessory Installation: 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 composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

H. 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 are permanently watertight.

1. Install exposed flashing and trim that is without 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 performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 076100 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Custom-fabricated, flat-seam sheet metal roofing.
2. Substrate board.
3. Underlayment.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for fasciae and flashings that installed as part of sheet metal roofing.

1.2 COORDINATION

A. Coordinate sheet metal roofing layout and seams with sizes and locations of roof curbs, equipment supports, equipment provided, and roof penetrations.

B. Coordinate sheet metal roofing installation with rain drainage work, flashing, trim, and construction of roofing substrate**,** parapets, walls, and other adjoining work to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review structural loading limitations of substrates during and after roofing installation.
3. Review underlayment requirements.
4. Review flashings, special roofing details, and condition of other construction that affect sheet metal roofing.
5. Review requirements for insurance and certificates if applicable.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Roofing sheet metal.
2. Substrate Boards.
3. Underlayment materials.
4. Fasteners.
5. Sealant tape.
6. Elastomeric sealant.
7. Butyl sealant.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and panel installation layouts, expansion joint locations, points of fixity, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include details for forming, including seams and dimensions.
4. Include details for joining and securing, including layout and spacing of fasteners, cleats, and other attachments. Include pattern of seams.
5. Include details of expansion joints, including showing direction of expansion and contraction from points of fixity.
6. Include details of roof penetrations.
7. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, corners, flashings, and counterflashings.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail the following accessory items, at scale of not less than 1-1/2 inches per 12 inches:

    a. Flashing and trim.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Include listing of completed projects of comparable scale of this Project, including name, address, telephone, and contact person for Architect, and name, address, telephone number, and contact person for building Owner.

B. Evaluation Reports: For self-adhering, high-temperature sheet underlayment, from ICC-ES.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing sheet metals and accessories to include in maintenance manuals.

B. Special warranties.

1.7 QUALITY ASSURANCE

A. Sheet Metal Roofing Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal roofing similar to that required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal roofing materials away from uncured concrete and masonry.
2. Protect stored sheet metal roofing materials from contact with water.

B. Protect strippable protective covering on sheet metal roofing from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal roofing installation.

1.9 WARRANTY

A. Special Warranty: Warranty form at end of this Section in which Installer agrees to repair or replace components of sheet metal roofing 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, rupturing, cracking, or puncturing.
b. Wrinkling or buckling.
c. Loose parts.
d. Failure to remain weathertight, including uncontrolled water leakage.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering, including nonuniformity of color or finish.
f. Galvanic action between sheet metal roofing and dissimilar materials.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing 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 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sheet metal roofing system, including, but not limited to, metal roof panels, cleats, anchors and fasteners, sheet metal flashing integral with sheet metal roofing, fascia panels, trim, underlayment, and accessories, shall comply with requirements without failure due to defective manufacture, fabrication, or installation, or due to other defects in construction. Sheet metal roofing shall remain watertight.

B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 ROOFING SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209 alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Thickness: 0.040 inch unless otherwise indicated.
2. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.

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

    a. CertainTeed Corporation.
    b. Georgia-Pacific Gypsum LLC.
    c. National Gypsum Company.
    d. USG Corporation.

2. Thickness: 1/2 inch.
3. Surface Finish: Factory primed or unprimed as recommended by roofing membrane manufacturer based upon performance requirements.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F or higher.

2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.5 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete roofing system and as recommended by primary sheet metal manufacturer unless otherwise indicated.

B. Fasteners: Wood screws, annular-threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. General:

a. Exposed Fasteners: Heads matching color of sheet metal roofing, using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of roofing.
b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed; with hex-washer head.
c. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

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

D. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal roofing and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187.

G. Underlayment Adhesive:

1. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.
2. Cold-Applied Polymer-Modified Asphalt Adhesive: Underlayment manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with underlayment.

2.6 ACCESSORIES

A. Sheet Metal Accessories: Provide components required for complete sheet metal roofing assembly, including trim, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items. Match material and finish of sheet metal roofing unless otherwise indicated.

1. Cleats: Intermittent and continuous attachment devices for mechanically seaming into joints and formed from the following materials and thicknesses unless otherwise indicated:

   a. Aluminum Roofing: 0.0250-inch-thick stainless steel.

2. Expansion-Type Cleats: Cleats of a design that allows longitudinal movement of roof panels without stressing panel seams; of same material as other cleats.
3. Backing Plates: Plates at roofing splices, fabricated from material recommended by SMACNA's "Architectural Sheet Metal Manual."
4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible-closure strips; cut or premolded to match sheet metal roofing profile. Provide closure strips where necessary to ensure weathertight construction.
5. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 0.018 inch thick.

2.7 FABRICATION

A. Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation. Fabricate sheet metal roofing and accessories in shop to greatest extent possible.

   1. Flat-Seam Roofing: Form flat-seam panels from metal sheets 20 by 28 inches with 1/2-inch notched and folded edges.

B. Fabrication Tolerances: Fabricate sheet metal roofing that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal roofing that is capable of installation to tolerances specified in MCA's "Metal Roof Installation Manual."

D. Form exposed sheet metal work to fit substrates with little oil canning; free of buckling and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

   1. Lay out sheet metal roofing, so transverse seams, if required, are made in direction of flow, with higher panels overlapping lower panels.
   2. Offset transverse seams from each other 12 inches inchesminimum.
   3. Fold and cleat eaves and transverse seams in shop.
   4. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements indicated on Drawings and as required for leakproof construction.

E. Expansion Provisions: Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work.

   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

F. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to SMACNA's "Architectural Sheet Metal Manual."

G. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item required. Obtain field measurements for accurate fit before shop fabrication.

1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
2. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. 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.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices of sizes recommended by SMACNA's "Architectural Sheet Metal Manual" for application, but not less than thickness of metal being secured.

H. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for drainage, flashings, and penetrations through sheet metal roofing.

B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Lay out panel arrangement before installation of sheet metal roofing.

3.3 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. 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.

3.4 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering High-Temperature Sheet Underlayment:

1. Install self-adhering high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days of installation.
8. Install self-adhering high-temperature underlayment over entire roof.

B. Install flashings to cover underlayment according to requirements in Section 076200 "Sheet Metal Flashing and Trim."

3.5 INSTALLATION, GENERAL

A. Install sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for complete roofing system.
2. Install sheet metal roofing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Do not field cut sheet metal roofing by torch.
5. Provide metal closures at rake edges and eaves.
6. Flash and seal sheet metal roofing with closure strips at eaves, rakes, and perimeter of all openings. Fasten with self-tapping screws.
7. Locate and space fastenings in uniform vertical and horizontal alignment. Predrill panels for fasteners.

8. Lap metal flashing over sheet metal roofing to direct moisture to run over and off roofing.
9. Do not use graphite pencils to mark metal surfaces.

B. Thermal Movement: Rigidly fasten metal roof panels to structure at only one location for each panel.

1. Allow remainder of panel to move freely for thermal expansion and contraction.
2. Point of Fixity: Fasten each panel along a single common line of fixing located at eave.
3. Avoid attaching accessories through roof panels in manner that inhibits thermal movement.

C. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating, by applying self-adhering sheet underlayment to each contact surface, or by other permanent separation as recommended in SMACNA's "Architectural Sheet Metal Manual."

1. Coat concealed side of uncoated-aluminum sheet metal roofing with bituminous coating where roofing contacts wood, ferrous metal, or cementitious construction.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Fasciae:

1. Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws.
2. Flash and seal sheet metal roofing with closure strips where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 INSTALLATION OF CUSTOM-FABRICATED SHEET METAL ROOFING

A. Install sheet metal roofing system with lines and corners of exposed units true and accurate.

1. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering metal temper and reflectivity.
2. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
3. Fold back sheet metal to form hem on concealed side of exposed edges unless otherwise indicated.

B. Install cleats to hold sheet metal roofing panels in position.

1. Attach each cleat with at least two fasteners to prevent rotation.
2. Space cleats not more than 12 inches o.c.
3. Bend tabs over fastener head.
4. Provide expansion-type cleats for roof panels that exceed 30 feet in length.

C. Seal joints as required for watertight construction. For roofing with 3:12 slopes or less, use cleats at transverse seams.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.
e. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

D. Flat-Seam Roofing:

1. Attach flat-seam metal panels to substrate with cleats, starting at eave and working upward toward ridge.
2. After panels are in place, apply sealant and mallet seams tight.
3. Attach roofing panels with cleats spaced not more than 24 inches o.c. Lock and solder panels to base flashing.
4. Attach edge flashing to face of roof edge with continuous cleat fastened to roof substrate at 12-inch o.c. spacing. Lock panels to edge flashing and apply sealant.

3.7 INSTALLATION OF ACCESSORIES

A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion.

1. Coordinate installation with flashings and other components.
2. Install components required for complete sheet metal roofing assembly, including trim, seam covers, flashings, sealants, gaskets, fillers, metal closures, closure strips, and similar items.
3. Install accessories integral to sheet metal roofing that are specified in Section 076200 "Sheet Metal Flashing and Trim" to comply with that Section's requirements.

B. Flashing and Trim: Comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual."

1. Provide concealed fasteners where possible, and install units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
3. Install flashing and trim as required to seal against weather and to provide finished appearance, including, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
4. Install continuous strip of self-adhering underlayment at edge of continuous flashing overlapping self-adhering underlayment, where "continuous seal strip" is indicated in SMACNA's "Architectural Sheet Metal Manual" and on Drawings.
5. Install exposed flashing and trim without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.

6. Install sheet metal flashing and trim to fit substrates, and to result in waterproof and weather-resistant performance.
7. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

    a. Space expansion joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
    b. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, and filled with butyl sealant concealed within joints.
    c. Use lapped expansion joints only where indicated on Drawings.

3.8 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. On completion of sheet metal roofing installation, clean finished surfaces as recommended by sheet metal roofing manufacturer.

C. Clean off excess sealants.

3.10 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal roofing is installed unless otherwise indicated in manufacturer's written installation instructions.

B. Prohibit traffic of any kind on installed sheet metal roofing.

C. Maintain sheet metal roofing in clean condition during construction.

D. Replace sheet metal roofing components that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name**>.
2. Owner's Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building's Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: <**Insert date**>.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: <**Insert date**>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner 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 Roofing Installer will, at Roofing Installer's 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 74 mph;
    c. Fire;
    d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. Faulty construction of parapet walls, 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 Owner.

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 Owner 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 Owner 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 Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner 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. Owner 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 Owner from other remedies and resources lawfully available to Owner 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 Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reveals.

   2. Formed low-slope roof sheet metal fabrications including fasciae and roof-edge specialties.

B. Related Requirements:

   1. Section 074113 "Standing Seam Metal Roof Panels" for flashing and trim provided as part of metal roofing installation.

   2. Section 074213.23 "Metal Composite Material Wall Panels" for flashing and trim provided as part of wall panel installation.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site in conjunction with roofing conference.

   1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
   3. Review requirements for insurance and certificates if applicable.
   4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

   1. Underlayment materials.
   2. Elastomeric sealant.
   3. Butyl sealant.
   4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

   1. Include plans, elevations, sections, and attachment details.

2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of edge conditions, including eaves, flashings, and counterflashings.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

B. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: 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.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.7 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.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

A. Special Warranty on Finishes: 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.

B. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

C. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, 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. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on approved roofing shop drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.

2. Color: Match Architect's sample.
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 minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl-adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Source Limitations: Obtain underlayment from single source from single manufacturer.
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

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

D. Elastomeric Sealant: When exposed or partially exposed in metal joints: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: Where concealed in metal joints: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. 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.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

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 cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. 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.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. **Roof Edge Flashing (Gravel Stop) and Fascia Cap**: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
   1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
   2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
   3. Fabricate from the following materials:
      a. Aluminum: 0.050 inch (1.27 mm) thick.

B. **Roof and Roof-to-Wall Transition Expansion-Joint Cover**: Shop fabricate interior and exterior corners. Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

   1. Aluminum: 0.040 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

   1. Aluminum: 0.040 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

   1. Aluminum: 0.040 inch thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Reveals: Fabricate from the following materials:

   1. Aluminum: 0.050 inch (1.27 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, 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.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment, wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Extend counterflashing 4 inches over base flashing.
2. Lap counterflashing joints minimum of 4 inches.

3. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

3.5 INSTALLATION TOLERANCES

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

3.6 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.7 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. 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, as determined by Architect.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

B. Related Requirements:

1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.
2. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.
3. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

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-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

B. Manufacturer Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

C. Field-Adhesion-Test Reports: For each sealant application tested.

D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD 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.
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.

1.8 WARRANTY

A. Special Installer's Warranty: 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 Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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

2.1 JOINT SEALANTS, 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. Colors of Exposed Joint Sealants: As scheduled, or if not scheduled, as selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; Pecora 890FTS/TXTR.
b. Sika Corporation; Joint Sealants; Sikasil WS-290 or Sikasil WS-290 FPS.
c. Tremco Incorporated; Spectrem 1.

C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Pecora Corporation; Pecora 864NST or Pecora 895NST.
    b. Sika Corporation; Joint Sealants; Sikasil WS-295.
    c. Tremco Incorporated; Spectrem 2.

2.3 SILICONE JOINT SEALANTS

A. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.

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

    a. Pecora Corporation.
    b. Sika Corporation; Joint Sealants.

B. Silicone, M, P, 100/50, T, NT: Multicomponent, pourable, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade P, Class 100/50, Uses T and NT.

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

    a. Sika Corporation; Joint Sealants.
    b. The Dow Chemical Company.

2.4 URETHANE JOINT SEALANTS – INTERIOR USE

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT. Paintable.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. BASF Corporation; MasterSeal NP 1.
    b. Pecora Corporation; Dynatrol I-XL.
    c. Sika Corporation; Joint Sealants; Sikaflex-211.
    d. Tremco Incorporated; Dymonic 100.

B. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT. Paintable.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. BASF Corporation; MasterSeal NP 2.
    b. Pecora Corporation; Dynatred.
    c. Sika Corporation; Joint Sealants; Sikaflex 2c NS EZ Mix.
    d. Tremco Incorporated; Dymeric 240.

C. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal SL 1.
b. Pecora Corporation; NR-201.
c. Sherwin-Williams Company (The); Stampede 1SL.

D. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal SL 2.
b. Pecora Corporation; Urexpan NR 200.
c. Sika Corporation; Joint Sealants; Sikaflex 2c SL.
d. Tremco Incorporated; THC 900/901.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; Pecora 860.
b. Sika Corporation; Joint Sealants; Sikasil-N Plus US.
c. Tremco Incorporated; Tremsil 200.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bostik, Inc; Chem-Calk 300.
b. Pecora Corporation; BC-158.

2.7 LATEX JOINT SEALANTS

A. Acrylic Latex: Siliconized acrylic latex, ASTM C834, Type OP, Grade NF. Paintable.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; MasterSeal NP 520.

b. Pecora Corporation; AC-20.
c. Sherwin-Williams Company (The); 950A Siliconized Acrylic Latex Caulk, White.
d. Tremco Incorporated; Tremflex 834.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, 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.

2.9 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.

PART 3 - EXECUTION

3.1 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 performance of the Work.

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

3.2 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.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

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. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

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.

3.3 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 C1193 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 C1193 unless otherwise indicated.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 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.

3.5 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 EXTERIOR JOINT-SEALANT SCHEDULE

A. Exterior concealed watertight joints in metal cladding systems.

1. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant; Movement Class 100/50.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
3. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant; Movement Class 50/50.
4. Joint-Sealant Color: As selected by Architect from manufacturer's full range. Multiple colors required to match several conditions.

B. Exterior vertical joints between different materials listed above.

1. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant; Movement Class 50/50.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range. Multiple colors required to match several conditions.

C. Exterior control and expansion joints in ceilings and other overhead surfaces.

1. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range. Multiple colors required to match several conditions.

D. All other exterior non-traffic joints.

1. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant; Movement Class 50/50.

E. Exterior horizontal nontraffic and traffic isolation joints.

1. Joint Sealant: Single- or multiple component pourable silicone sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

3.7 INTERIOR JOINT-SEALANT SCHEDULE

A. Vertical control and expansion joints on exposed interior painted gypsum board surfaces of exterior wall.

1. Joint Sealant: Single component nonsag urethane sealant.
2. Joint-Sealant Color: Custom match to adjacent wall color, or paintable product.

B. Interior perimeter joints of exterior openings.

1. Joint Sealant: Single component nonsag urethane sealant.
2. Joint-Sealant Color: Custom match to adjacent wall color, or paintable product.

C. Interior sanitary joints between plumbing fixtures, food preparation fixtures, and casework and adjacent walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
2. Joint-Sealant Color: Translucent, unless otherwise selected by Architect from manufacturer's full range to match multiple conditions.

D. Perimeter non-moving joints between interior painted surfaces and adjacent materials.

1. Joint Sealant: Siliconized acrylic sealant.
2. Joint-Sealant Color: White; paintable.

E. Traffic joints in floor and between floor and wall construction.

1. Joint Sealant: Multicomponent pourable urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Pecora Corporation; AC-20 FTR.
    b. Tremco Incorporated; Tremco Acoustical Sealant.
    c. USG Corporation; SHEETROCK Acoustical Sealant.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. 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.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 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 acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 088000 "Glazing" for safety glazing installed in hollow metal doors and frames.

1.2 DEFINITIONS

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

1.3 COORDINATION

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

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

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

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Deansteel Manufacturing Company, Inc.
4. Fleming Door Products Ltd.; Assa Abloy Group Company.
5. Mesker Door Inc.
6. Pioneer Industries.
7. Republic Doors and Frames.
8. Steelcraft; an Allegion brand.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
a. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.

b. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, at wet locations including group toilet rooms, locker rooms, janitor's closets, mechanical rooms.
c. Edge Construction: Model 2, Seamless.
d. Core: Manufacturer's standard.

2. Frames:

a. Materials: Uncoated and Metallic-coated steel sheet, minimum thickness of 0.053 inch.
b. Interior Frames for Sound Rated Openings: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.053nominal thickness or thicker as required to provide STC rating indicated.
c. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
d. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber 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 E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

A. Door 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 beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite 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 welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

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

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: 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 without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
4. Masonry Walls: Do not fill frames with grout.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus, or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

b. Alignment: Plus, or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus, or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus, or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, **electrical** characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For **exterior** components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

5. Show locations of controls, locking devices, and other accessories.
6. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.

2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
2. .

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

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

1. Cookson Company.

2. Cornell.

3. ENTREMATIC.

4. McKeon Rolling Steel Door Company, Inc.

5. Overhead Door Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 SERVICE DOOR ASSEMBLY, INTERIOR

A. Interior Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Door Curtain Material: Aluminum.

D. Door Curtain Slats: Flat profile slats of 1-7/8-inch to 2-5/8-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

E. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8-inch-thick; fabricated from material and finished to match door.

F. Curtain Jamb Guides: Material and exposed finish matching curtain slats.

G. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: Face of wall.

H. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Wall.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.

4. Motor Exposure: Interior.

5. Motor Electrical Characteristics: Refer to Electrical Drawings.
6. Emergency Manual Operation: Push-up type.
7. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

a. Sensor Edge Bulb Color: Black.

8. Control Station(s): Interior mounted.
9. Other Equipment: Audible and visual signals.

I. Curtain Accessories: Equip door with push/pull handles.

J. Door Finish:

1. Aluminum Finish: Clear anodized.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.
3. at face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding wind locks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.7 CURTAIN ACCESSORIES

A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation

of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 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.

2.11 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine locations of electrical connections.

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

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 083453 - SECURITY DOORS AND FRAMES

1.1 SUMMARY

A. Section Includes:

1. Swinging security doors.
2. Security frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware not included in this Section.

1.2 DEFINITIONS

A. Minimum-Thickness Steel: Indicated as the specified minimum thicknesses for base metal without coatings, according to NAAMM-HMMA 803.

1.3 COORDINATION

A. Coordinate installation of anchorages for security frames. 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 adjacent construction. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, label compliance, and finishes for each security door and frame type specified.

B. Shop Drawings: In addition to requirements below, provide a schedule using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door type.
2. Direction of swing.
3. Secure and public sides.
4. Details of doors, including vertical and horizontal edge details, and metal thicknesses.
5. Details of frames, including dimensioned profiles, and metal thicknesses.
6. Locations of reinforcement and preparations for hardware.
7. Details of each different wall opening condition.
8. Details of anchorages, joints, field splices, and connections.

9. Details of conduits, junction boxes, and preparations for electrified door hardware.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Product Test Reports: For each type of security hollow-metal door and frame assembly including vision and side lights, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.7 QUALITY ASSURANCE

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

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver security hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver security frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store security hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance, UL 752: Listed and labeled as level indicated when tested according to UL 752.

2.2 SECURITY DOOR AND FRAME ASSEMBLIES

A. Manufacturers: Provide products by one of the following:

1. Ambico
2. Bullet Guard Corporation.
3. Ceco.
4. Total Security Solutions

B. Security Door and Frame Assemblies: Provide security door and frame assemblies that comply with the following, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project:
   1. Bullet Resistance: Level 3 rated when tested according to UL 752.

C. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, prehung on continuous hinge.

   1. Doors:

      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches.
      c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch.
      d. Core: Non-ricochet type with fiberglass core.

   2. Frames:

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

D. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

2.3 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B.

C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

D. Post-Installed Anchors: Torque-controlled expansion anchors.

   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

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

2.4 FABRICATION

A. Fabricate security doors and frames rigid, neat in appearance, and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and

invisible. 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 security doors and frames to comply with manufacturing tolerances indicated in NAAMM-HMMA 863.

C. Hardware Preparation: Factory prepare security doors and frames to receive mortised hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final Door Hardware Schedule and templates provided by security door hardware supplier.

1. Reinforce security doors and frames to receive surface-mounted door hardware. Drilling and tapping may be done at Project site.
2. Locate door hardware according to NAAMM-HMMA 863.

D. Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM-NOMMA 500, "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish security doors and frames after assembly.

2.6 STEEL SHEET FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning".

B. Factory Priming for Field-Painted Finish: Apply shop primer specified in "Shop Primer" Subparagraph below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mil.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, corrosion-inhibiting, lead- and chromate-free, universal primer complying with SDI A250.10 acceptance criteria; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2.7 ACCESSORIES

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security frame connections before security frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION

A. General: Install security doors and frames plumb, rigid, properly aligned, and securely fastened in place, complying with Drawings, schedules, and manufacturer's written instructions.

B. Anchorage: Set security frame anchorage devices according to details on Shop Drawings and according to anchorage device manufacturer's written instructions.
   1. Embedded Anchors: Install embedded plates in wall surrounding frame openings to match frame angle locations.
   2. Postinstalled Anchors: Drill holes in existing construction at locations to match bolt locations, and install bolt expansion shields or inserts.

3.3 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 security doors and frames that are warped, bowed, or otherwise unacceptable.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior manual-swing entrance doors.

B. Related Requirements:

1. Section 084413 "Glazed Aluminum Curtain Walls" for coordination of finishes and shared components.
2. Section 087100 "Door Hardware" for balance of door hardware for aluminum entries not specified in this Section.
3. Section 088000 "Glazing" for glazing units to be installed in aluminum-framed entrances.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances. 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 type of vertical-to-horizontal intersection of aluminum-framed entrances, 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. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

A. **Qualification Data**: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For aluminum-framed entrances, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance utilizing specified glazing units.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

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 Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the nonstructural sealants of a structural glazed system.

1. Testing will not be required if data based on previous testing of current sealant products match those submitted.
2. Compatibility: Test materials or components using ASTM C1087.
3. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
4. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances 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: Five years from date of Substantial Completion.

a. Deterioration of metals and other materials beyond normal weathering.
b. Water penetration through fixed glazing and framing areas.
c. Failure of operating components.

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

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances shall withstand movements of supporting structure, including, but not limited to, 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: As indicated on Drawings.
2. 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, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceed specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and 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. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor):

a. Entrance Doors: 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 (SHGC):

a. Not more than 0.22 as determined according to NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

4. Condensation Resistance Factor (CRF):

a. Entrance Doors: CRF of not less than 63 as determined according to AAMA 1503.

H. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

2.2 SOURCE LIMITATIONS

A. Work of other Sections: Obtain all components of aluminum-framed entrance system from manufacturer of components for Section 084413 "Glazed Aluminum Curtain Walls."

2.3 ENTRANCE DOOR SYSTEMS

A. Basis-of-Design Products: Subject to compliance with requirements, provide Kawneer North America, an Arconic company; 350 Standard Entrance Doors and Frames or a comparable product by one of the following:

1. EFCO Corporation.
2. Oldcastle BuildingEnvelope (OBE); CRH Americas.
3. Tubelite Inc.
4. U.S. Aluminum; a brand of C.R. Laurence.
5. YKK AP America Inc.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: Minimum 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.

2. Door Design: Stile width as indicated on Drawings. Align mid-rail centered on exit devices where applicable.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.

1. **Sequence of Operation**: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene.

C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

D. Door Hardware: Balance of door hardware specified in Section 087100.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers identical to those used in tested assemblies meeting Performance Requirements.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by weatherseal-sealant and glazed storefront manufacturers for this use.

1. Color: As selected by Architect from manufacturer's full range of colors.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
4. Primer: 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.

2.7 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.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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 A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC Filler: At outside of frame to improve installation of backer rod and perimeter sealant by providing support for backer rod.

F. Flexible Filler: Where detailed at head deflection joints: Flexible compressible foam, lightweight, non-staining polyethylene closed-cell expansion joint filler.

1. Product: W.R. Meadows, Deck-O-Foam Expansion Joint Filler, or comparable product acceptable to Architect.

2.8 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 for vision glass and exterior for spandrel glazing or metal panels.
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. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: At Entry Doors and Frames: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. 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.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.6 FIELD QUALITY CONTROL

A. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of three tests in areas as directed by Architect.
b. Prepare test and inspection reports.

B. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems.

    a. Conventionally glazed.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Section 088000 "Glazing" for curtain wall glazing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Shop Drawings: For glazed aluminum curtain walls. 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 type of vertical-to-horizontal intersection of glazed aluminum curtain walls, 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.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C1401. Include periodic quality-control reports.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

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 Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCKUPS

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

1. Build in-place mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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.

1.8 WARRANTY

A. Special Assembly Warranty: Manufacturer and Installer jointly agree to repair or replace components of glazed aluminum curtain wall 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 and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

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

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls 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: As indicated on Drawings.
2. 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, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

E. Structural: Test in accordance with ASTM E330/E330M 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. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system 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 (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.22 as determined according to NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 35 as determined according to AAMA 1503.
b. Entrance Doors: CRF of not less than 63 as determined according to AAMA 1503.

H. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing, entrances and accessories, from single manufacturer.

B. Work of other Sections: Obtain all components of aluminum-framed entrance and storefront system from manufacturer of components for Section 084113 "Aluminum Framed Entrances and Storefronts."

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America; an Alcoa company; 1600UT System 1, or a comparable product by one of the following:

1. EFCO Corporation.
2. Tubelite Inc.
3. U.S. Aluminum; a brand of C.R. Laurence.
4. YKK AP America Inc.

B. 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.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Clear anodic finish.
5. Fabrication Method: Either factory- or field-fabricated system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Door Systems: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts".

2.5 GLAZING

A. Curtain Wall Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: As selected by Architect.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

2.7 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, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

E. Adjustable Partition Enclosure: Accessory closure at intersection with partitions. Size to match opening. With brake-formed end cap.

1. Basis of Design Product: Gordon Mullion Mate.
2. Finish: Match storefront framing finish.

F. Flexible Filler: Where detailed at head deflection joints: Flexible compressible foam, lightweight, non-staining polyethylene closed-cell expansion joint filler.

1. Product: W.R. Meadows, Deck-O-Foam Expansion Joint Filler, or comparable product acceptable to Architect.

2.8 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 exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

3.5 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on representative areas of glazed aluminum curtain walls.

C. Field Quality-Control Testing: Testing Agency will perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.
   b. Other doors to the extent indicated.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.
4. Keyways.

B. Related Sections:

1. Section 064113 "Wood-Veneer-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
4. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.
5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
6. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead grille assemblies.
7. Section 084113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.
8. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, except cylinders.
9. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.
10. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
11. Section 283111 "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.
12. Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connections to building fire-alarm system.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site. Attendees shall include doors hardware supplier, door hardware installer, electrical subcontractor, Architect, Owner, and Owner's security consultant if applicable.

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. Inspect and discuss preparatory work performed by other trades.

3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.
6. Review required post-construction adjustment of door hardware.
7. Submit minutes of conference.

B. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, Installer, and Architect, conference participants shall also include Supplier's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Requirements for coordination with access control.
5. Address for delivery of keys.
6. Submit minutes of conference.

C. **Hardware Installation Seminar**: Coordinate a hardware installation seminar to be conducted on the installation of hardware, specifically of locksets, closers, exit devices. Manufacturer's representative of the above products shall present this seminar. Seminar shall be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training shall include use of installation manuals, hardware schedule, templates and physical products samples. Submit minutes of seminar.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: For power, signal, and control wiring and including the following:

a. Details of interface of electrified door hardware and building safety and security systems.
b. Provide point to point and elevation view diagrams of door hardware and electronic hardware. Coordinate with Door Access Control Installer.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.

a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
c. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
5) Fastenings and other pertinent information.
6) Explanation of abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for door hardware.
8) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks and padlocks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. **Installer Qualifications**: Provide certificate of manufacturer training acceptable to Owner for each installer performing work of this Section.

B. **Product Certificates**: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Minutes of Preinstallation Meetings.

D. Field Quality Control reports.

E. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

B. **Bitting Schedule**: For keying schedule for Project, reflecting decisions made in keying conference and modifications required prior to Substantial Completion. Submit directly to Owner.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish one additional complete set of each hardware type specified. Deliver to CMS Locksmith Shop.

1. Provide complete list of maintenance material submittals to Architect with copy to Owner's Representative.

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of installers and supervisors who are trained and certified by product manufacturers for installation of specified products on two-year periodic repeating basis, carrying manufacturer training identification.

B. Installer shall have demonstrated capability to provide the following:

1. Warehousing Facilities: In Project's vicinity.
2. Material Scheduling: Preparation of fully-detailed door hardware and keying schedules.

C. Supplier Qualifications and Responsibilities: A recognized architectural hardware supplier that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides a certified Architectural Hardware Consultant (AHC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Coordinate installation of the electronic security hardware with the Architect and electrical engineers and provide installation and technical data to the Architect and other related subcontractors.
5. Upon completion of electronic security hardware installation, coordinate with access control Installer to inspect and verify that all components are working properly.

D. Manufacturer's Field Representative: A technical representative of manufacturer not engaged in the sale of products who is experienced in the specification, installation, and maintenance of the specified products, qualified to perform inspection specified in Field Quality Control Article.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to Owner by registered mail or overnight package service.

1.9 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Electrical System Roughing-In: Coordinate with the door access control contractor, storefront contractors, and other security related contractors who have work related to door openings the layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

C. **Existing Openings**: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. **Magnetic Door Holders**: Five years from date of Substantial Completion.
b. Exit Devices: Three years from date of Substantial Completion.
c. Manual Closers: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and accessibility requirements of North Carolina State Building Code for door hardware on doors in an accessible route.

B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

C. **Smoke- and Draft-Control Door Assemblies**: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

D. **Electrified Door Hardware**: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

2.2 DOOR HARDWARE, GENERAL

A. General: Provide door hardware for each door to comply with requirements in this Section, door hardware sets indicated in door and frame schedule, and door hardware sets indicated in Division 08 Section "Door Hardware Schedule".

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Division 08 Section "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

C. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products comparable to the scheduled products by the manufacturers specified.

D. Source Limitations: Obtain door hardware items from a single approved manufacturer for each type of door hardware.

2.3 HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

1. Two Hinges: For doors with heights up to 60 inches.
2. Three Hinges: For doors with heights 61 to 90 inches.
3. Four Hinges: For doors with heights 91 to 120 inches.
4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

B. Template Requirements: Except for hinges to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

C. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.4 HINGES

A. Hinges: Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

B. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Material	Bearing	IVE	HAG	MCK	STH
2.	Steel	2BB	5BB1	BB1279	TB2714	FBB179
3.	Steel	4BB	5BB1HW	BB1168	T4B3786	FBB168
4.	Stainless	4BB	5BB1HW630	BB1199	T4B3386	FBB199

C. Plain-Bearing Hinges: For interior openings through 36 inches wide with or without a door closer.

1. Mounting: Full mortise (butts).
2. Bearing Material: Ball bearing.
3. Grade 3 (standard weight).
4. Outswinging Corridor Doors with Locks: Nonremovable pins or NRP.
5. Tips: Flat button.
6. Corners: Square.

D. Antifriction-Bearing Hinges: For exterior doors, interior doors over 36 inches wide, and for all vestibule doors.

1. Mounting: Full mortise (butts).
2. Material: Stainless steel for exterior doors; steel allowable for all other unless otherwise scheduled.
3. Bearing Material: Ball bearing.
4. Grade: Grade 1 (heavy weight).

5. Pins: Nonremovable: Outswinging exterior doors, lockable out-swinging interior doors, and where scheduled.
6. Tips: Flat button.
7. Corners: Square.

E. Sizes: Furnish hinges in the following sizes:

1. 5 by 5 inches: For doors 48 inches or wider.
2. 4-1/2 by 4-1/2 inches: For doors less than 48 inches wide.

2.5 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1-inchbolt throw.

C. Lock Backset: 2-3/4 inches, unless otherwise indicated.

D. Lock Trim: Lockset Design, Levers, Escutcheons, Roses: As indicated by basis of design products.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

F. Mortise Locks:

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company,
c. Schlage; an Allegion brand.

2. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

a.	Application	SCH	SAR	CR
b.	Classroom	L9070	8237	ML2003
c.	Office	L9050	8205	ML2051
d.	Storeroom/Custodial/Coop/Trash	L9080	8204	ML2057
e.	Mechanical	L9080	8204	ML2057
f.	Electrical < 1200amps	L9080	8204	ML2057

g.	Electrical > 1200amps	99L-F(VD)	Panic	Panic
h.	RES: Study/Lounge/Kitchen	L9070	8237	ML2003
i.	Non-egress door between rooms	L9466	8226	ML2022
j.	Multi-Person Restroom	L9463	8403	ML2017
k.	Single Restroom	L9040	8265	ML2060
l.	Single Staff Restroom	L9486	49-8251	ML2029xM19V
m.	Card Reader Doors	L9080EU	8270	ML20903

2.6 ELECTRIC POWER TRANSFERS

A. Power Transfers: Provide type fully concealed in door and frame when door is closed, formed with solid steel tube, with mortar guard.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2.	Application	Von Duprin	ASSA	ABH
3.	Concealed Two Wire	EPT-2	CEPT-10	PT200
4.	Concealed Ten Wire	EPT-10	CEPT-10	PT1000

2.7 DOOR POSITION SWITCHES

A. Door Position Switches: Concealed type.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2.	Application	Schlage	Sentrol	Securitron
3.	Concealed	679 Series	1076W	DPS Series

2.8 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2.	Application	Ives	Door Controls	Hager
3.	Dust Proof Strike	DP2	80	280X
4.	Auto Flush Bolt (Metal and Wood Doors)	FB31P	842	292D

2.9 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items:

1. Provide devices that are UL approved for types and functions scheduled.
2. Provide devices with dogging feature on all exit devices except exit devices installed in fire-rated openings. Supply one dogging key for each unit.
3. Provide latch bolts with deadlocking feature.
4. Provide metal end caps.
5. Equip exit devices with glazing frame kit when installed where device spans across a view light.
6. Pattern punch push pad exit devices to designate Code requirements.

B. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

C. Removable Mullions: BHMA A156.3. Hex key type only

D. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

E. Outside Trim: Lever; Lever with cylinder; Pull; Pull with cylinder; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

F. Through Bolts: For exit devices and pull trim on all metal and wood doors.

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

1. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
2. SARGENT Manufacturing Company; ASSA ABLOY.
3. Von Duprin; an Allegion brand.

H. Products Subject to compliance with requirements, provide one of the following:

1.	Application Function	VD	SAR	CR
2.	Rim Panic	99 Series	___	___
3.	Exterior alum entrances (Single)	XP99 Series	___	___
4.	Exterior alum entrances (Pair)	4954 Mullion x XP99	___	___
5.	Surface Vertical Rod Device	9927 LBR	___	___
6.	Impact Devices (HM doors secure)	9547	___	___
7.	Impact Devices (HM doors non-secure)	9547 LBR	___	___
8.	Exterior Trim	990 Series	___	___
9.	Quiet latch retraction	QEL	___	___
10.	Power transfer (at electrified devices or locks)		EPT	___ ___
11.	Power Supply (Electric latch retraction devices)		PS914 x 900-2RS	___ ___

I. Applications

1. Pairs of exterior doors: Two rim exit devices with hex key removable mullion.
2. Pairs of cross-corridor doors: Two vertical rod exit devices less bottom rod (LBR).
3. Single exterior doors: One rim exit device (no lever trim).
4. Single interior doors: One rim exit device.
5. Equip exit devices with sound-dampening feature.
6. At full glass doors provide devices with no exposed fasteners on the back of mechanism visible through glass.
7. Provide flush end caps on all devices.
8. Equip devices with dead-locking latchbolts.
9. Provide cylinders matching lockset cylinders where required.
10. Where specified, provide standard, non-keyed steel removable mullions for pairs of doors.

2.10 LOCK CYLINDERS

A. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Six.
2. Type: As required at scheduled device.

B. Lock Cylinders: BHMA A156.30; Grade 1; Type M, mechanical; permanent cores; face finished to match lockset.

1. Number of Pins: Six.
2. Type: As required at scheduled device.

C. Permanent Cores: Manufacturer's standard; finish face to match lockset:

D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Manufacturer: Same manufacturer as for locks and latches.

2.11 PADLOCKS

A. Pin-coded key-in-knob exterior-use security padlocks for equipment and gates with 2-1/8-inch body and 5/16 inch diameter hardened shackle. Provide with weather protective cover and rekeyable six-pin cylinders keyed according to approved keying schedule for Project.

1. Basis of Design: American Lock, Model 5560 Series. Contact CMS Locksmith for special pinning instructions prior to ordering padlockes.

2.12 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

B. Products: Refer to Alternates article for requirements for Owner's preferred keyway alternate.

1. Subject to compliance with requirements, provide one of the following from manufacturer of mortise locksets:

2. Application	Schlage	SAR	CR
3. Restricted keyway cylinders	C145	XC	Access3

4. **Master Key System**: Cylinders are operated by a change key and a master key.
5. **Grand Master Key System**: Cylinders are operated by a change key, a master key, and a grand master key.

6. **Existing System**: Master key or grand master key locks to Owner's existing system.
7. Temporary Construction Keying Systems:

a. Furnish temporary construction keyed cores at openings indicated by Owner as hazard areas.
b. Construction control and operating keys shall not be part of the Owner's permanent keying system or furnished on the same keyway as the Owner's permanent keying system.
c. Install all of the permanent cores into the locks and exit devices prior to substantial completion.

C. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra key blank for each lock, provide the following:

a. Cylinder Change Keys: Three per lock.
b. Master Keys: Six.
c. Grand Master Keys: Two.
d. Exit Device Hex Keys: One for each exit device.

3. Cutting: Provide factory-cut keys. Provide 100 blank keys for use by the CMS Lockshop.
4. All keys to be delivered by registered mail to the Owner. Change keys shall be delivered in a set up key cabinet. Construction keys shall be delivered to the Contractor

2.13 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock. Furnish complete with cam lock, permanent key tags, and change key cards. Prepare all key change index records, tag all keys and place permanent file keys in cabinet
2. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

3.	Lund	Key Control	Telkey
4.	2600 Series	6l Series	CDF Series

B. Cross-Index System: Single**-**index system for recording key information. Include three receipt forms for each key-holding hook. Set up by key control manufacturer.

C. Key Access Accessories:

1. Lock Boxes: Designed for storage of four keys: Knox Company, 3200 series. Two required.
2. Padlocks: At vehicle gates: Keyed to match Knox keys.

2.14 OPERATING TRIM

A. Operating Trim: Stainless steel, unless otherwise indicated.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2.	Item	Ives	Hager	Rockwd
3.	Straight Pull (1" dia., 10" ctc)	8103EZ-0	4J	111
4.	Straight Pull (3/4" dia., 8" ctc)	8102-8	3G	107
5.	Pull / Push-Bar (1" dia., 10" ctc Pull)	9103EZ-0	153	111x47
6.	Push Plate (.050 4"X 16")	8200 4 x 16	30S 4 x 16	70 4x16
7.	Push Plate (.050 6"X 16")	8200 6 x 16	30S 6 x 16	70 6x16
8.	Pull Plate (1" dia., 10" ctc)	8303EZ-0 6 x 16	34J 6 x 16	111x70
9.	Straight Pull (At flush interior push / pull doors)		8103EZ-0	

2.15 ACCESSORIES FOR PAIRS OF DOORS

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

1. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
2. Burns Manufacturing Incorporated.
3. Door Controls International, Inc.
4. Hager.
5. Ives; an Allegion brand.
6. Trimco.

B. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

C. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

D. Astragals: BHMA A156.22.

2.16 SURFACE CLOSERS

A. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and North Carolina State Building Code.

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.

C. Alternates: Refer to Alternates article for requirements for Owner's preferred surface closer alternate.

D. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

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

   a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
   b. LCN; an Allegion brand.
   c. SARGENT Manufacturing Company; ASSA ABLOY.

E. Products: Subject to compliance with requirements, provide one of the following:

a.	Installation	LCN	Sargent	CR
b.	Ext and Corridor	4040XP MC EDA	281 x MC	DC8000 x MC
c.	Interior	4040XP MC EDA	281 x MC	DC8000 x MC

F. Application:

1. Do not furnish closers with CUSH function.
2. Attach closers using thru-bolts supplied by closer manufacturer.
3. Provide extra heavy-duty arm (EDA) when closer is to be installed using parallel arm mounting.
4. Closers shall utilize cast iron cylinders, forged main arms, and 1-piece forged steel pistons.
5. Closers shall utilize table fluid withstanding temperature range of 120 deg F to -30 deg F without requiring seasonal adjustment of closer speed. Closers for fire-rated doors shall be provided with temperature stabilizing fluid meeting UL10C.
6. Provide closers with full metal covers supplied by closer manufacturer.
7. Provide closers with separate adjusting valves for sweeps, latch, and backcheck.
8. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.
9. Provide closers with adjustable spring power. Size closers to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.
10. Install closers on room side of corridor doors, stair side of stairways, and interior side of exterior doors.
11. Furnish closers complete with mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.
12. Unless otherwise specified, mount all closers parallel arm.

2.17 LOW-ENERGY AUTOMATIC OPERATORS

A. Provide automatic operators as specified in hardware groups. Provide complete with drop plates, brackets, or adapters for arms as required to suit details.

B. Provide wall-mounted actuator switches by the same manufacturer as the operator. Actuators shall be weather-resistant type at exterior applications.

C. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Item	LCN	Horton
2.	Electro-Mechanical Operator	9500 Senior Swing	4000 Series

2.18 MECHANICAL STOPS AND HOLDERS

A. Stops and Bumpers:

1. Where wall stop will adequately stop door, provide wall stops.
2. Where wall stops are not applicable, provide floor stops on floors not indicated to receive carpet and where floor stop will not be located in the line of traffic.
3. Where wall stops or floor stops are not applicable, provide overhead stop.

B. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

C. Wall Stops: Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Application	Ives	Hager	Rockwood
2.	Wrought Convex Wall Bumper	WS406CVX	232W	__
3.	Wrought Concave Wall Bumper	WS406CCV	236W	__
4.	Extended Wall Stop	WS11/WS11X	255W	__
5.	Extended Wall Stop	WS33/WS33X	__	__
6.	Automatic Wall Holder	WS40	254W	__

7. Furnish a stop or holder for all doors.
8. Furnish floor stops only where scheduled.
9. Do not provide holder function for labeled doors.

D. Floor Stops: Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Application	Ives	Hager	___
2.	Floor Stop	FS436	241F	___
3.	Heavy Duty Floor Stop	FS441	257F	___

4. Furnish a stop or holder for all doors. Furnish floor stops only where specifically specified.
5. Do not provide holder function for labeled doors.

2.19 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: Wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies. Provide armature secured with set screw.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2.	Application	LCN	ABH	Rixson
3.	Wall Holder with Metal Housing	SEM 7800	2000	990 Series

4. Magnetic holder's housing and armature shall be constructed of a die cast zinc material.

2.20 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

2.21 DOOR GASKETING

A. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

a. Do not cut weatherstrip to install other hardware.

2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
4. Kerfed Frame Gasketing: Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.

B. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Application	Zero	NGP	Reese	Pimco
2.	Weatherstrip	429	700N	755	__
3.	Adhesive Gasket	188	5050	797	__
4.	Mullion Seal/Silencer	8780	5100N	___	__
5.	Meeting Edge Seals	8193	9605	959	__
6.	Adhesive Edge Seal	117S	5060	798	__
7.	Automatic Door Bottom (Surface Mtd.)	321	222	320	__
8.	Automatic Door Bottom (HD Concealed) (When Sealing Against A Solid Surface)	360	423N	430	__
9.	Automatic Door Bottom (HD Concealed) (When Sealing Against Carpet)	360	683	943	__
10.	Sweeps 39A	201N	323	__	__
11.	Sweep w/ drip	8197	C627	354	__
12.	Drip Cap	142	16	R201	__ __

13. Provide drip cap for all exterior HM frames, unless positioned under a canopy.

C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784. Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.

F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408. Provide gasketing suitable for installation in kerfed hollow metal frames where applicable.

1. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

2. Application	Zero	NGP	Reese	Pimco
3. Adjustable Perimeter Sound Seals	870AA	__	__	__
4. Adjustable Perimeter Sound Seals	770SP	105NA	599C	__
5. Mullion Seal/Silencer	8780	5100N	__	__
6. Meeting Edge Seals	55AA	140SA	95CP	__
7. Automatic Door Bottom (Surface Mtd.)	321	222	320	__
8. Automatic Door Bottom (HD Concealed) (When Sealing Against A Solid Surface)	360	423N	430	__
9. Automatic Door Bottom (HD Concealed) (When Sealing Against Carpet)	360	683	943	__
10. Automatic Door bottom (HD Concealed with Magnet used to hold seal up)	369A	__	__	__
11. Threshold	566A	950	257A	__

12. Application: Provide sound seals for band rooms, media centers, and all music rooms.

G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

H. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

I. Rain Drip: Provide unit wider than door size. Provide at exterior hollow metal doors where door head is not protected by canopy.

J. Astragals: Provide steel astragals at all double egress doors, pairs of rated and/or smoke doors, and pairs of exterior doors.

2.22 THRESHOLDS

A. Thresholds: Fabricated to full width of opening indicated.

B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and North Carolina State Building Code.

1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.

D. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 655A for all exterior openings with an interior floor finish less than or equal to 1/4" in height.

2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

E. Products: Subject to compliance with requirements, provide the products of a single manufacturer selected from the following:

1.	Application	Zero	NGP	Reese	Pimco
2.	Saddle Thresholds	655	425	S205	___
3.	Half Saddle Thresholds	1674	324	S239	___

2.23 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

B. Armor Plates: 36 inches high by 2 inches LTDW; 36 inches high by 1-inch LTDW on pairs of doors.

C. Application: Provide armor plates for loading dock doors.

1. Protective plates shall be 2-inch LTDW, or 1-inch LTDW at pairs.
2. All protective plates shall be beveled 4 sides and have counter sunk screw holes.
3. Do not provide protection plates over 16 inch for labeled doors unless specifically approved by door manufacturer's listing.
4. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.24 MISCELLANEOUS DOOR HARDWARE

A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

B. Peephole: One-way, 190 deg. view, solid brass with satin chrome finish, at 60 inches AFF.

1. Ives, 698B26D or comparable product by Hager, Rockwood.

2.25 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

    a. Wood or Machine Screws: For the following:

        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.

    b. Steel Through Bolts: For the following unless door blocking is provided:

        1) Closers to doors and frames.
        2) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.26 FINISHES

A. Provide finishes complying with BHMA A156.18 as follows:

1.	HARDWARE ITEM	BHMA FINISH AND BASE MATERIAL
2.	Butt Hinges: Exterior, or Non-Ferrous	630 (US32D)
3.	Butt Hinges: Interior	652 (US26D)
4.	Continuous Hinges	628 (US28)
5.	Flush Bolts	626 (US26D)
6.	Exit Devices	626 (US26D)
7.	Locks and Latches	626 (US26D)
8.	Pulls and Push Plates/Bars	630 (US32D)
9.	Coordinators	600 (Prime painted or mill alum.)
10.	Closers 689 (Powder Coat Aluminum)	
11.	Protective Plates	630 (US32D)
12.	Wall Stops and Holders	630 (US32D)
13.	Thresholds	628 (Mill Aluminum)
14.	Weather-strip, Sweeps Drip Caps	Aluminum Anodized
15.	Magnetic Holders	Sprayed Aluminum
16.	Magnetic Locks	628 (US28)
17.	Miscellaneous	626 (US26D)

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI**/**SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

~~C.~~ Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height.

D. Closers: Install closers to provide maximum permissible swing of doors.

1. Install closers on the inside of building and inside of rooms.
2. Provide initial settings for operating force and opening range in accordance with accessibility requirements.
3. Install closers using through-bolts.

E. Lock Cylinders: Install permanent cores and during the construction period use construction key to secure building and areas during construction period.

F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies required for items specified in this Section, as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Doorstops shall be installed on all doors and type shall be as follows:

1. Exterior doors opening out: Wall stops.
2. Masonry wall locations: Provide wall stops.
3. Drywall locations: Coordinate blocking within the wall prior to wall stop installation.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Contractor's Inspection: Contractor shall engage a qualified manufacturer's field representative to perform inspections and to prepare inspection reports.

1. Manufacturer's representative shall inspect door openings and door hardware and state in report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
2. Manufacturer's Installation Review: The lock, exit device and door closer manufacturers' representative shall complete an installation review and post installation review for proper adjustment and installment of exit devices and closers prior to building turnover. Submit written report.
3. Review includes review of hardware furnished under this Section and installed under Section 084113 "Aluminum-Framed Entrances and Storefronts."

B. Correction of Work: Repair or remove and replace door hardware items where inspections and installation reviews indicate that they do not comply with specified requirements.

1. Verification of Correction: Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements. Submit written report.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DOOR HARDWARE SETS

A. Refer to Division 08 Section "Door Hardware Schedule."

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for doors, glazed curtain walls, and windscreens.
2. Glazing sealants and accessories.

B. Related Requirements:

1. Section 088853 "Security Glazing" for ballistic-rated security glazing units.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

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

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include principal center-of-glass performance metrics for each exterior glazing unit type.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 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. Preconstruction adhesion and compatibility test report.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than four Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.9 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.

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.

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 Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 5 years from date of Substantial Completion.

C. 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

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

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

2.2 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. 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: As indicated on Drawings.

2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. 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 laminated glass lites, properties are based on products of construction indicated.
2. 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.
3. 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.
4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

G. Color Variation of Coated Glass: Provide vacuum deposition coatings on glass complying with color variation limits specified in ASTM C 1376.

2.3 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. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. 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. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

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. 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. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 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.

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:

a. Maximum peak-to-valley roll wave 0.003 inch in the central area of the glass lite, and 0.008 inch within 12 inches of the leading and trailing edge of the lite, measured in accordance with ASTM C 1651.
b. Maximum center-kink of 0.001 inch when roll wave is measured over the surface of the glass perpendicular to the direction of travel through the tempering furnace.
c. Maximum localized and overall bow (warp) per lite shall be 0.031 inch per lineal foot: one-half of maximum allowed by ASTM C 1048.
d. Measure glass lites for optical distortion by on-line distortion measurement system. Retain test reports for three years following substantial completion. Submit test reports upon Architect's request.

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.

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:

a. Maximum peak-to-valley roll wave 0.003 inch in the central area of the glass lite, and 0.008 inch within 12 inches of the leading and trailing edge of the lite, per measured in accordance with ASTM C 1651.
b. Maximum center-kink of 0.001 inch when roll wave is measured over the surface of the glass perpendicular to the direction of travel through the tempering furnace.
c. Maximum localized and overall bow (warp) per lite shall be 0.031 inch per lineal foot: one-half of maximum allowed by ASTM C 1048.
d. Measure glass lites for optical distortion by on-line distortion measurement system. Retain test reports for three years following substantial completion. Submit test reports upon Architect's request.

D. Ceramic-Coated Spandrel Glass: ASTM C 1048, Kind FT (fully tempered); Type I, Condition B, Quality-Q3.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.

2.6 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. Provide insulating glass units free of skips or voids in the primary or secondary seals. Utilize an automated vertical insulating line for insulating glass unit assembly, sealing, and curing processes.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
2. Perimeter Spacer: Nonmetallic laminate or Nonmetallic tube.

a. Available Products: Subject to compliance with requirements, available productds include the following:

1) Technoform; TGI-Spacer.
2) Thermix; a brand of Ensinger USA; Thermix.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.
4. Edge Deletion: Delete low-E coating prior to fabrication of insulating units according to coated glass manufacturer’s instructions.

2.7 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
3. Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT. SWRI validation certificate.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; 890NST.
b. Sika USA; SikaSil WS-290.
c. The Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
d. Tremco Incorporated; Spectrem 1.

2. Applications: Metal-to metal and glass-to-metal.

C. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT. SWRI validation certificate.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; 864NST; 895NST 896.
b. Sika USA; SikaSil WS-295; WS-295 FPS.
c. The Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
d. Tremco Incorporated; Spectrem 2; Spectrem 3.

2. Applications: Metal-to metal and glass-to-metal; metal frames to perimeter cladding.

D. Neutral-Curing Silicone Glazing Sealant, Class 50, Non-Staining: Complying with ASTM C920, Type S, Grade NS, Use NT. SWRI validation certificate.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; 864NST; 895NST.
b. Sika USA; SikaSil WS-295; WS-295 FPS.
c. The Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
d. Tremco Incorporated; Spectrem 2; Spectrem 3.

2. Applications: Metal-to metal and glass-to-metal; metal frames to perimeter cladding where perimeter materials may be absorbant.

2.8 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 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. 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.

2.9 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).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 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, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

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

B. Examine glazing units to locate 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.

3.3 GLAZING, GENERAL

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

B. 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.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

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.

3.4 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. Apply heel bead of elastomeric sealant.

G. 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.

H. Apply cap bead of elastomeric sealant over exposed edge of tape where fixed stop is indicated for exterior glazing.

3.5 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 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.

D. Install gaskets so they protrude past face of glazing stops.

3.6 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.

3.7 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.

3.8 SECURITY GLAZING

A. For ballistic glazing units, refer to Section 088853 "Security Glazing.

3.9 MONOLITHIC GLASS SCHEDULE

A. Glass Type **GL-1**: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing label required.

3.10 LAMINATED GLASS SCHEDULE

A. Glass Type **GL-2**: Clear laminated glass, with two plies of fully tempered float glass, windborne-debris-impact-resistant.

1. Minimum Thickness of Each Glass Ply: 6 mm.
2. Interlayer Thickness: 0.090 inch.
3. Safety glazing label required.
4. Application: Windscreen.

3.11 INSULATING-LAMINATED-GLASS SCHEDULE

A. Glass Type **IGU-1**: High performance low-E-coated, clear insulating glass, windborne-debris-impact-resistant.

1. Outdoor Lite: Heat-strengthened float glass.

a. Overall unit thickness: 1-5/16 inch.
b. Minimum Thickness of Outdoor Glass Lite: 6 mm.
c. Low-E Coating: Sputtered on second surface.
d. Basis of Design Product: Guardian Industries, Inc., Viracon VRE 1-43 or comparable product by one of the following:

1) Guardian Industries.
2) Vitro Architectural Glass (formerly PPG)

2. Interspace Content: Air.
3. Indoor Lite: Two plies of fully tempered float glass.

a. Minimum Thickness of Each Glass Ply: 5 mm, and as required to meet performance requirements.
b. Minimum Thickness of Interlayer: 0.090 inch, and as required to meet performance requirements.

4. Winter Nighttime U-Value: 0.28.
5. Visible Light Transmittance: 41 percent minimum.
6. Solar Heat Gain Coefficient: 0.22 maximum.
7. Outdoor Visible Light Reflectance: 25 percent maximum
8. Safety glazing label where required.

B. Glass Type **TIGU-1**: Same as IGU-1, except provide fully tempered outdoor lite.

C. Glass Type **SIGU-1**: Same as IGU-1 with ceramic frit on 3th surface.

1. Basis of Design: Varacon, Viraspan Subdued Gray V903.

D. Glass Type **SIGU-2**: Same as SIGU-1 with tempered outer lite.

END OF SECTION

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Glass-clad polycarbonate.
2. Bullet-resistant framing.

B. Related Sections include the following:

1. Section 112217 "Bullet-Resistant Teller Equipment" for bullet-resistant barriers and other products used at Ticket Windows.

1.2 DEFINITIONS

A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

1.3 COORDINATION

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

1.4 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 security glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For Security Glazing Samples: For each type of security glazing; 12 inches square.

C. Delegated-Design Submittal: For security glazing indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers.

B. Product Certificates: For each type of product indicated, from manufacturer.

C. Product Test Reports: For each type of security glazing, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.

B. Security Glazing Testing Agency Qualifications: Subject to compliance with requirements, testing agency is one of the following:

1. H. P. White Laboratory, Inc.
2. Underwriters Laboratories, Inc.
3. Wiss, Janney, Elstner Associates, Inc.

C. Sealant Testing Agency Qualifications: Qualified according to ASTM C1021 for testing indicated.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations 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 below 40 deg F.

1.11 WARRANTY

A. Manufacturer's Special Warranty for Glass-Clad Polycarbonate: Manufacturer agrees to replace glass-clad polycarbonate that deteriorates within specified warranty period. Deterioration of glass-clad polycarbonate is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass-clad polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced glass-clad polycarbonate standard, yellowing, and loss of light transmission.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same types of lites, plies, interlayers, and spacers for each security glazing type indicated.

B. Source Limitations for Glazing Sealants and Gaskets: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General:

1. Installed security glazing shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing; or other defects in construction.
2. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design security glazing.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 SECURITY GLAZING, GENERAL

A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council. Label shall indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

D. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F or more when tested according to ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke-Developed Index of 450 or less when tested according to ASTM E84, or smoke density of 75 or less when tested according to ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch or less when tested according to ASTM D635 at a nominal thickness of 0.060 inch or thickness indicated for the Work.

E. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance, UL 752: Listed and labeled as level indicated when tested according to UL 752.

2.4 BULLET-RESISTANT FRAMING

A. Provide vision security windows with framing on four sides and no operable sash or ventilator.

1. Basis of Design: Subject to compliance with requirements, provide Total Security Solutions: TSS-650 or comparable products by one of the following:

a. Bullet Guard.
b. C.R. Laurence Inc.
c. North American Bullet Proof.
d. Total Security Solutions
e. U. S. Bullet Proofing.

B. Ballistic Resistance: Level 3 according to UL 752.

C. Framing: Fabricate with two-piece perimeter framing with storefront appearance from aluminum as follows:

1. Profile: Narrow, with two-inch face dimension.
2. Depth: Manufacturer's standard.

D. Aluminum Materials:
1. Aluminum Extrusions: ASTM B221 (ASTM B221M). Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength.
2. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M).
3. Finish: Clear anodized.

2.5 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For heat-strengthened float glass, comply with requirements for Kind HS.
3. For fully tempered float glass, comply with requirements for Kind FT.
4. For uncoated glass, comply with requirements for Condition A.
5. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.6 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
2. Interlayer Color: Clear unless otherwise indicated.

2.7 POLYCARBONATE SECURITY GLAZING

A. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.

B. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C1349 for maximum allowable laminating process blemishes and haze.

C. Glass-Clad Polycarbonate: ASTM C1349.

D. Security Glazing Type **SG-1**: Clear glass-clad polycarbonate.

1. Products: Subject to compliance with requirements, provide products by one of the following:

a. Bullet Guard.
b. C.R. Laurence Inc.
c. North American Bullet Proof.
d. Total Security Solutions
e. U. S. Bullet Proofing.

2. Ballistic Resistance: Level 3 according to UL 752.
3. Maximum Overall Unit Thickness: 1-1/4 inches.
4. Outer Ply (threat): 9-mm heat-strengthened float glass.
5. Multiple Core: Laminated glass, and polycarbonate.

6. Interlayer Material: Polyurethane.
1. Inner Ply (secure): 9-mm heat-strengthened float glass.
2. Visible Light Transmission: 75 percent.
3. Provide safety glazing labeling.

2.8 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, 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 security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range**.**

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

C. Security Sealant: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with low movement complying with ASTM C920, Grade NS, Class 12.5 or 25, Use NT, and with a Shore A hardness of at least 45 when tested according to ASTM C661.

2.9 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 security glazing manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. 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.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing 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 security glazing manufacturer to maintain security glazing lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.11 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
2. Prepare security windows for field glazing unless preglazing at the factory is indicated.

B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

C. Glazing Stops: Finish glazing stops to match security window framing.

1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

F. Fabricate security glazing 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.

G. Grind smooth and polish exposed security glazing edges and corners.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

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

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Minimum required face or edge clearances.
3. Minimum required bite.
4. Effective sealing between joints of framing members.

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

3.2 PREPARATION

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

B. Examine glazing units to locate exterior (threat0 and interior (secure) surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

3.4 GLAZING, GENERAL

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

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and appearance.

C. Install security glazing in bullet-resistant barrier systems in accordance with manufacturer's recommendations using sealant and glazing accessories approved by barrier manufacturer to ensure compliance with bullet-resistant protection level specified.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. 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 security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

C. Wash security glazing on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Manufacturer Stud Height and Deflection Limitation Charts: Manufacturer's standard charts with applicable selected studs indicated, consistent with minimum requirements in Part 2.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by building code.

E. Horizontal Deflection Limits: L/120, except L/360 for partitions faced with tile.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated

2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

    a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: AISI S220.

1. Steel Studs and Tracks:

    a. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection [, but not less than 0.0296.

    b. **Minimum Base-Steel Thickness**: At framing to receive cementitious tile backer units or impact-resistant gypsum board: 0.0329 inch.
    c. Depth: As indicated on Drawings.

C. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.

1. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.

2. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2-inch minimum vertical movement.
2. Single Long-Leg Track System: ASTM C645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs' friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of 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.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0538 inch.

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C645.

1. Minimum Base-Steel Thickness: 0.0296 inch.
2. Depth: As indicated on Drawings.

I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch not less than HW 12/0.1055 inch in diameter and meeting CISCA standard for the applicable seismic zone and the suspension system manufacturer's written recommendations.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

1. Depth: 2 inches, unless otherwise indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Tracks: ASTM C645.

a. Minimum Base-Steel Thickness: 0.0269 inch.
b. Depth: As indicated on Drawings.

3. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.

a. Minimum Base-Steel Thickness: 0.0190 inch.
b. Depth: As indicated on Drawings.

4. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.

a. Minimum Base-Steel Thickness: 0.0296 inch.

5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock; fire-rated where indicated on Drawings.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. **Partial Wall Framing Connection to Floor**: Configured to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track:

1. Basis of Design Product: Pony Wall, by ClarkDietrich.
2. Web Depth: 3-5/8 inches.
3. Anchor Plate: 2-3/8 b 5-1/2 by 3/8 inches.
4. Height: Use tallest manufactured item that will fit application.

C. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch-thick, in width to suit steel stud size.

D. **Outlet Box Isolation Pad**: Resilient acoustical and fire-resistant wall opening protective material for isolation and sealing of electrical outlets in wall construction, UL-classified.

1. Basis of Design Product: Kinetics Noise Control, Inc., Isobacker Acoustical Outlet Backer Putty Pad www.kineticsnoise.com/arch/isobacker.html.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

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

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

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

D. Install bracing at terminations in assemblies.

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

3.4 INSTALLING FRAMED ASSEMBLIES

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

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 24 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

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

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. **Fire-Resistance-Rated Partitions**: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. **Sound-Rated Partitions**: Install framing to comply with sound-rated assembly indicated.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

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

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 24 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Bullet-resistant panels

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For specified products.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Mockups: Build in-place mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 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.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 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 E90 and classified according to ASTM E413 by an independent testing agency.

C. Bullet-resistant panels: Ballistics Resistance, UL 752: Listed and labeled as level indicated when tested according to UL 752.

2.2 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.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

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

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

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

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8-inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

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 Corporation; FiberCement BackerBoard.
b. National Gypsum Company; PermaBase® Cement Board.
c. USG Corporation; USG Durock® Brand Cement Board.

2. Thickness: 5/8inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 BULLET-RESISTANT PANELS

A. Bullet-resistant panels: Composite panels of multiple layers of fiberglass roving impregnated with thermoset resin and compressed into rigid sheets.

B. Basis of Design: TSS Total Armor. or comparable product by one of the following:

1. Armortex.
2. Bullet Guard.
3. North American Bullet Proof.
4. Total Security Solutions
5. U. S. Bullet Proofing.
6. Waco Composites; ArmorCore.

C. Ballistic Resistance: Level 3 per UL 752.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc; Plastic.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

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 or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. 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 C919 and with manufacturer's written instructions 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.

K. Install bullet-resistant panels behind gypsum board panels where indicated in accordance with manufacturer’s written instructions.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Mold-Resistant Type: At exterior walls, wet areas, and as indicated on Drawings.
3. Ceiling Type: Ceiling surfaces.

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 vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. 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 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. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF 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 C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. Curved-Edge Cornerbead: Use at curved openings.

3.6 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 C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.7 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

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Stone thresholds.
3. Waterproof membrane.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for coordination of requirements for depressed concrete slabs at locations of full-bed tile installations, and for use of suitable curing methods compatible with installation of floor finishes.
2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 092900 "Gypsum Board" for tile backing panels.

1.2 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. Face Size: Actual tile size, excluding spacer lugs.

C. Module Size: Actual tile size plus joint width indicated.

D. Large Format Tile: Tile with one or more edges 15 inches or more in length.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

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. Full-size units of each type of trim and accessory for each color and finish required.
3. **Stone thresholds** in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. **Installation Schedule**: Provide written description of installation methods and procedures to be used at each type of installation required. Cross reference to Installation Types Schedule in Part 3. Include copies of TCNA Installation Methods cited.

1.6 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, rounded up to the nearest full carton, in a sealed and labeled carton.
2. Grout: Furnish quantity of grout equal to one full package or container installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Experienced installer employing workers trained by manufacturer of installation materials, with record of successful performance on similar projects.

2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of product and installation types specified for Project.

B. Mockups: Build in-place 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 tile installation, when requested by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.9 COORDINATION

A. Coordinate locations and depth required for slab depressions for installation of ceramic tile.

1. Provide minimum 2-inch-deep slab depression at quarry tile.

B. Permanent Lighting: Coordinate installation of permanent lighting prior to commencement of wall tile installation.

1.10 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type from single 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.
2. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
3. Obtain waterproof membrane and crack isolation membrane, from manufacturer of setting and grouting materials.

B. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single listed manufacturer:

1. Stone thresholds.
2. Metal edge strips.

2.2 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 grade equal to that of Basis of Design product.

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 TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. 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.

D. 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.

2.3 TILE PRODUCTS

A. Through-body porcelain tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile Santini or comparable product by one of the following:

a. American Marazzi Tile, Inc.
b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Daltile.
e. Florida Tile, Inc.
f. Interceramic.
g. Seneca Tiles, Inc.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: Nominal 12 by 24 inches .
4. Face Size Variation: Rectified.
5. Thickness: 5/16 inch.
6. Face: Plain with square or cushion edges.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations.

B. Grout Color: As selected by Architect from manufacturer's full range.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. **Polyethylene Sheet**: Where sheet goods are required: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Schluter Systems L.P; KERDI.
    b. Schönox; HPS North America, Inc.; Schonox AB.

C. **Fluid-Applied Membrane**: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ARDEX Americas; ARDEX 8+9™ Rapid Waterproofing and Crack Isolation Compound.
    b. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane.
    c. Custom Building Products; CBP-9240 Waterproofing & Anti-Fracture Membrane RedGard; SpeedCoat Waterproofing Membrane; RedGard Waterproofing and Crack Prevention Membrane.
    d. H.B. Fuller Construction Products Inc. / TEC; Hydraflex Waterproofing Crack Isolation Membrane.
    e. LATICRETE SUPERCAP, LLC; Laticrete Hydro Ban Waterproofing Crack Isolation Membrane; Laticrete Hydro Barrier Waterproofing Crack Isolation Membrane.
    f. MAPEI Corporation; Mapelastic AquaDefense Waterproofing Crack Isolation Membrane.

D. Waterproof Membrane, Fabric-Reinforced, Fluid-Applied: 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; Custom® 9240 Waterproofing and Anti-Fracture Membrane.
    b. Laticrete International, Inc.; LATICRETE 9235 Waterproofing Membrane.
    c. Schonox HPS North America, Inc.; Schönox HA.

2.6 SETTING MATERIALS

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

1. ARDEX Americas.
2. Bonsal American, an Oldcastle company.
3. Custom Building Products.
4. H.B. Fuller Construction Products Inc. / TEC.
5. LATICRETE SUPERCAP, LLC.
6. MAPEI Corporation.

B. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.

3. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber 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.

C. LHT (Medium-Bed) Modified Dry-Set Mortar: Where recommended by manufacture due to tile dimensions: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

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 A118.15.

2.7 GROUT MATERIALS

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

1. ARDEX Americas.
2. Bonsal American, an Oldcastle company.
3. Custom Building Products.
4. H.B. Fuller Construction Products Inc. / TEC.
5. LATICRETE SUPERCAP, LLC.
6. MAPEI Corporation.

B. High-Performance Tile Grout: ANSI A118.7.

1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. At Food Service Facilities: Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

D. Joint Sealant: Silicone, S, NS, 25, T, NT: Single-component, nonsag or pourable, plus 25 percent and minus 25 percent movement capability, Shore A hardness not less than 35, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade N or P, Class 25, Uses T and NT.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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 thinset 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.
    c. Verify that substrate tolerances comply with TCNA allowable variations for the applicable tile types.

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 Architect.

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

C. Permanent Lighting: Proceed with installation of wall tile only once permanent lighting has been installed.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset 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 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 to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA 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 TCNA 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 consisting of tiles 8 by 8 inches or larger.
c. Tile floors consisting 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. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. 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.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 3/16 inch.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on approved Shop Drawings. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where expansion and isolation joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Where saw-cut crack control joints occur in slabs on ground, relocate joint to nearest tile grout joint using fabric-reinforced, modified-bituminous sheet crack isolation membrane per TCNA F125 Partial.

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
2. Do not extend cleavage membrane waterproofing or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproofing, or crack isolation membrane with elastomeric sealant.

J. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Extend waterproofing membrane to drain flanges and flashed up perimeter walls and in-field interruptions including columns, chases, and wing walls to form watertight installation.

C. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove 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.

3.6 PROTECTION

A. 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.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. For tile types and locations, refer to Room Finish Schedule.

B. Interior Floor Installations, Concrete Subfloor:

1. Waiting and other dry locations: TCNA F113; thinset mortar.

   a. Ceramic Tile Type: Through-body porcelain.
   b. Thinset Mortar: LHT (Medium bed modified dry set) mortar.
   c. Grout: High-performance sanded grout.

2. Toilet Rooms and other wet and intermittently wet area: TCNA F121 and ANSI A108.1C; cement mortar bed (thickset) on waterproof membrane.

   a. Ceramic Tile Type: Through-body porcelain.
   b. Bond Coat for Cured-Bed Method: LHT (Medium-bed, modified dry-set) mortar.
   c. Grout: Water-cleanable epoxy.

C. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Wall Installation: TCNA W244C or TCNA W244F; thinset mortar over full waterproofing membrane on cementitious backer units.

   a. Thinset Mortar: Latex- portland cement mortar.
   b. Fluid-applied waterproofing membrane.
   c. Grout: Water-cleanable epoxy grout.
   d. Application: Porcelain tile or Glazed wall tile: Toilet rooms or showers.

2. Ceramic Tile Wall Installation: TCNA W244C or TCNA W244F; thinset mortar cementitious backer units.

   a. Thinset Mortar: Latex- portland cement mortar.
   b. Grout: Water-cleanable epoxy grout.

c. Application: Porcelain tile or Glazed wall tile: Dry area installations.

D. Interior Wall Installations, Metal Studs or Furring:

1. Waiting and other dry areas: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: Porcelain Tile.
b. Thinset Mortar: LHT (Medium bed modified dry set) mortar.
c. Grout: Cementitious Grout

2. Toilet rooms and other intermittently wet areas: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

a. Ceramic Tile Type: Porcelain Tile.
b. Thinset Mortar: LHT (Medium bed modified dry set) mortar.
c. Grout: Water cleanable epoxy grout.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Acoustical panels.
2. Exposed suspension systems for ceilings.
3. Ceiling-mounted acoustical accessories.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of manufacturer's standard size samples of each type, finish, and color.
3. Clips: Full-size hold-down, impact, and seismic clips, if required for Project.

1.4 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. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, 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

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide basis of design product indicated below or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. USG Corporation.

2.4 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

B. Water-Felted, Mineral-Base Acoustical Panels for Acoustical Panel Ceiling

1. Basis of Design: Armstrong Cirrus
2. Classification: type III, Form 1, Pattern E I.
3. Color: White.
4. NRC: Not less than 0.70.
5. Edge Detail: Square.
6. Thickness: 7/8 inch.
7. Size: 24 by 24 inches.
8. Grid: 15/16-inch intermediate.

2.5 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C635/C635M.

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, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum.
5. Cap Finish: Painted white.
6. Application: All areas unless otherwise indicated.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: At high humidity locations: ASTM A 580/A 580M, Type 304, nonmagnetic.

3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch-diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8-inch-wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.7 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; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.

2.8 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079200 " Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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.

3.2 PREPARATION

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

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both 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.
6. 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.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

    a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners' level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 095423 - LINEAR METAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Linear metal ceilings.

1.2 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For linear metal ceilings.

1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:

a. Linear ceiling patterns and joints.
b. Ceiling suspension members.
c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
e. Ceiling perimeter and penetrations through ceiling; trim and moldings.

C. Samples: For each exposed product and for each type, color, and finish specified, 12 inches long in size.

D. Samples for Initial Selection: For units with factory-applied colors and finishes.

1. Include Samples of accessories involving color and finish selections.

E. Samples for Verification: For the following products:

1. Linear Metal Pans: 12 inches long by full-width Samples of each type, color, and finish and a 12-inch-long spliced section.
2. Suspension-System Members: 12-inch-long Sample of each type.
3. Exposed Molding and Trim: 12-inch-long Samples of each type, color, and finish.
4. Filler Strips: 12-inch-long Samples of each type, color, and finish.
5. Sound Absorbers: 12 inches long by full width.
6. End Caps: Full size.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each linear metal ceiling, for tests performed by a qualified testing agency.

C. Evaluation Reports: For linear-metal-ceiling framing systems.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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. Linear-Metal-Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by National Voluntary Laboratory Accreditation Program for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle ceiling components and accessories in a manner that prevents damage.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure, the effects of gravity loads, and the following loads and stresses without showing permanent deformation of ceiling system components, including pans and suspension system; noise or metal

fatigue caused by vibration, deflection, and displacement of ceiling pans; or permanent damage to fasteners and anchors:

1. Wind Load: Uniform pressure indicated on Drawings, acting inward or outward.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

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

2.2 LINEAR METAL CEILING

A. Pans and Suspension System: Subject to compliance with requirements, provide Armstrong Metalworks Linear Classics or comparable product by one of the following:

1. Armstrong Ceiling and Wall Solutions.
2. CertainTeed
3. Gordon
4. Rulon
5. Rockfon.
6. USG

B. Metal Pans: Complying with ASTM E1264 for Type XX and formed to snap on to carriers securely, without separate fasteners.

1. Surface-Burning Characteristics: For metal-pan assemblies, including backings, determined by testing in accordance with ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

2. Metal: Electrolytic zinc-coated steel sheet, ASTM A879/A879M, 04Z coating; surface treatment as recommended by finish manufacturer for type of use and painted finish indicated.
3. Form: Nonperforated.
4. Pan Thickness: Not less than 0.028 inch.
5. Pan Edge Detail: Square with extended flange.
6. Pan Width: 2-inch module width and 1-1/4-inch face width 6-inch module width and 5-1/4-inch face width.
7. Pan Depth: 5/8 inch.
8. Metal-Pan Finish: Protected on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping and as follows:

a. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

1) Color and Pattern: Wood look, as selected by Architect from manufacturer's full range.

b. Exterior pans: Finish both sides.

C. Pan Splices: Formed for snap fit into butt-cut pans, 6 inches long.

1. Finish: Matching pan.

D. End Caps: Manufacturer's standard material fabricated to fit and conceal exposed ends of pans.

1. Finish: Matching pan.

E. Moldings and Trim: Manufacturer's standard for exposed members, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

F. Carrier Suspension System: Manufacturer's standard complying with requirements in ASTM C635/C635M for applications indicated; complete with carriers, splice sections, stabilizing components, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation.
2. Structural Classification: Heavy-duty system.
3. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
4. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers.
5. Carrier Splices: Same metal, profile, and finish as for carriers.

2.3 CARRIER-SYSTEM HANGERS, BRACES, AND TIES

A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provides not less than 0.106-inch-diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed from 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

F. Seismic Struts: Suspension-system manufacturer's standard compression struts designed to accommodate seismic forces.

G. Exterior Bracing: Cold-rolled steel channels and angles, hot-dip galvanized to comply with ASTM A653/A653M, G60 coating designation; size and profile as required to withstand wind load.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal 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 linear metal ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of linear metal pans.

1. Balance border widths at opposite edges of each ceiling.
2. Avoid using less-than-half-width pans at borders.

3.3 INSTALLATION

A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with 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. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, power-actuated fasteners, or postinstalled mechanical or adhesive anchors that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.

9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns in 1-1/2 inches. Suspend bracing from building's structural members as required for hangers and without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.

1. Screw attach moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system carriers so they are aligned and securely interlocked with one another.

1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
2. Remove and replace dented, bent, or kinked members.

F. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness.

G. Install linear metal pans in coordination with suspension system and exposed moldings and trim.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated on Drawings.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

a. Install pans with butt joints staggered a minimum of 12 inches using internal pan splices.

3. Where metal pan ends are visible, install end caps unless trim is indicated.

4. Install filler strips as required to close any gaps one inch or more.

3.4 CLEANING

A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings, after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, 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, including dented and bent units.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Rubber molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following 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 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following comparable to scheduled product if any, including scheduled color selections:

1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
2. Flexco.
3. Johnsonite; a Tarkett company.
4. Roppe Corporation, USA.

B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient floor coverings and no floor covering.

C. Thickness: 0.125 inch.

D. Height: 4 inches unless otherwise indicated on Drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As indicated by manufacturer's designations.

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following if providing acceptable match to scheduled products:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
3. Flexco.
4. Johnsonite; a Tarkett company.

B. Description: Rubber 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.

C. Profile and Dimensions: As approved by Architect.

D. Locations: Provide rubber molding accessories in areas described above subject to approval by Architect.

E. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type meeting sustainable design requirements, recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

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 resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 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; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical 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. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.3 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 manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing 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 Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.4 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.

1.5 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.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's 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 levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 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, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Bentley Prince Street, Inc.
2. Mohawk Group (The); Mohawk Carpet, LLC.
3. Patcraft; a division of Shaw Industries, Inc.
4. Shaw Contract Group; a Berkshire Hathaway company.
5. Tandus; a Tarkett company.

B. Backing/Backcoating: Manufacturer's standard composite materials comparable to Basis of Design product. PVC-free.

C. Size: As scheduled.

D. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment meeting Performance Requirements.

E. Performance Characteristics: Comparable to Basis of Design product

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

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

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

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

C. Concrete Substrates: 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 adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," 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. Maintain pile-direction patterns indicated on Drawings, or if not indicated, as recommended in writing by carpet tile manufacturer.

E. 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.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive 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 the Carpet and Rug Institute's CRI 104, Section 13.7.

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

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 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 and Project name.

1. Paint: 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); scheduled products, or comparable products by one of the following:

1. Benjamin Moore & Co.
2. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
3. Glidden Professional, Division of PPG Architectural Coatings.
4. PPG Architectural Coatings.
5. Pratt & Lambert

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. 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.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. 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 3.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Tanks and other equipment that do not have factory-applied final finishes.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards and switchgear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System:

a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
b. Topcoat: Sealer, water based, for concrete floors.

1) Sherwin-Williams;H & C Wet Look Sealer, 50.048054.

B. Steel Substrates:

1. Water-Based Light Industrial Coating System: Low-emitting materials compliant:

a. Prime Coat: Primer, alkyd based, anti-corrosive for metal: Primer, acrylic based, anti-corrosive for metal: S-W Pro Industrial Pro-Cryl Primer, B66-1300 Series.
b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss: S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating, B66-650 Series, at 6.0 to 12.0 mils wet, 2.2 to 4.4 mils dry, per coat.
d. Application: Interior and exterior surfaces of hollow metal doors and frames, and miscellaneous items requiring paint protection.

2. Water-Based Dry-Fall System: Low-emitting materials compliant:

a. Prime Coat: Where required: Primer, acrylic based, anti-corrosive for metal: S-W Pro Industrial Pro-Cryl Primer, B66-1300 Series.
b. Top Coat: Dry-fall latex, flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
c. Application: Exposed structure in finished areas.

3. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items.

C. Gypsum Board Substrates:

1. Latex System: Low-emitting materials compliant:

a. Prime Coat: Primer sealer, latex, interior: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
b. Intermediate Coat: Latex, interior, water based, matching topcoat.
c. Topcoat: At ceilings and soffits: Latex, interior, flat: S-W ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. **Topcoat: At walls**: Latex, interior, eggshell: S-W ProMar 200 Zero VOC Interior Latex Flat, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

END OF SECTION

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems.

B. Related Requirements:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 painting Sections for special-use coatings and general field painting.

1.3 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.5 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. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate selection of topcoats applied over intumescent fireproofing with Work of Section 078123 "Intumescent Fireproofing."

1.7 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F 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

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled products of Sherwin-Williams Company (The); or a comparable product by one of the following:

1. Benjamin Moore & Co.
2. Corotech Coatings; Benjamin Moore & Co.
3. Tnemec Company, Inc.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: As indicated in color schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 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.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.
3. Prepare horizontal traffic surfaces in accordance with coating manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 7/NACE No. 4, unless otherwise indicated.
2. SSPC-SP 10/NACE No. 3, for handrails and guardrails.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. 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.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. 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.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up 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.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing 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 to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Pigmented Polyurethane System:

a. Application: Exposed exterior steel framing and metal fabrication items and where epoxy paint or high-performance coating is indicated.
b. Prime Coat: Alkyd anti-corrosive, quick dry: S-W Kem Kromik Universal Primer, B62WZ111 Series, at 3 to 4 mils dry, per coat.
c. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
d. Topcoat: Polyurethane, two-component, pigmented, semi-gloss: S-W Acrolon 218 HS Acrylic Polyurethane, B65-650 Series, at 3.0 to 6.0 mils dry, per coat.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Steel Substrates:

1. Epoxy System: Water-based Catalyzed Epoxy, LEED v4.1 Emissions and VOC compliant:

a. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils dry, per coat.
b. Intermediate Coat: Epoxy, two-component polyamine, pigmented, matching topcoat.
c. Topcoat: Epoxy, two-component polyamine, semi-gloss: S-W Pro Industrial Water Based Catalyzed Epoxy, B73-300 Series, at 2.0 to 4.9 mils dry, per coat.

END OF SECTION

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.
2. Exposed Accessories: Full-size Sample of each accessory type.
3. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis of Design: Subject to compliance with requirements, provide ASI Sign Systems, Inc. InTouch or comparable product by one of the following:

a. InPro Corporation.
b. Mohawk Sign Systems.

2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: 0.50 inch.
b. Graphics, Font, and Color: As indicated.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Square cut.
b. Corner Condition in Elevation: Square.

4. Mounting: Surface mounted to wall with two-face tape.
5. Text and Typeface: Accessible raised characters and Braille. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

2.6 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls according to the accessibility standard.

C. Mounting Methods:
   1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 101426 - POST AND PANEL/PYLON SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Internally illuminated pylon signs.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete foundations, concrete fill in postholes, and setting anchor bolts in concrete foundations for signs.

1.2 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signage.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show locations of electrical service connections.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each exposed component for selection of color and finish.

D. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: 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.
c. Separation or delamination of sheet materials and components.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of pylon sign type(s) according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings.
2. Concentrated Horizontal Load: As indicated on Drawings.
3. Other Design Load: As indicated on Drawings.
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. 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.

2.2 PYLON SIGNS

A. Pylon Sign: Sign with smooth, uniform surfaces and support assembly; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers that may be able to fabricate and install pylon signs include, but are not limited to, the following:

a. Baton Rouge Sign Company, Baton Rouge, LA.

b. GrafxPlus, LaFayette, LA. .

c. Signorama, Baton Rouge, LA.

2. Framework: Internal frame of cold-formed steel.

3. Solid-Sheet Sign Panels and Returns: Aluminum composite material.

4. Light Box: Aluminum box with double-sided acrylic faces.

a. Lighting: LED.

b. Graphics: Painted logo, template to be provided by Owner.

2.3 DIMENSIONAL LETTERS

A. Cutout Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:
1. Character Material: Cast aluminum.
2. Character Height: As indicated on Drawings.
3. Thickness: Manufacturer's standard for size of character.
4. Finishes: Painted.
5. Mounting: Projecting studs.

2.4 MATERIALS

A. Aluminum Composite Material: As specified in Section 074213.23 "Metal Composite Material Wall Panels." Finish shall match panels on building.

B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Steel Materials:

1. Metallic-Coated Steel Sheet: ASTM A653/A653M, G90 coating, either commercial or forming steel.
2. Hot-Rolled, Structural-Steel Shapes: ASTM A36/A36M or ASTM A529/A529M.

3. Steel Members Fabricated from Plate or Bar Stock: ASTM A529/A529M or ASTM A572/A572M, 42,000-psi minimum yield strength.
4. Bolts for Steel Framing: ASTM A307 or ASTM F3125/F3125M, Grade A325 as necessary for design loads and connection details.
5. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or Polycarbonate Sheet: ASTM C1349roughness.

E. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

F. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.

B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC evaluations as appropriate for the substrate.

1. Uses: Securing signs with imposed loads to structure.
2. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Anchoring Materials:

1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

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

    a. Water-Resistant Product: At exterior locations, 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.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. 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 locations concealed from view after final assembly.
2. Mill joints to tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal fasteners and anchors unless indicated to be exposed; locate exposed fasteners where they will be inconspicuous.
4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.

B. Pylon Fabrication: Fabricate pylon signs with integral base consisting of channels, angles, plates, or other fittings. Design and fabricate pylon and anchorage for structural performance indicated. Detail anchorage so that water can drain out of assembly without obstruction. Drill holes in members for anchor-bolt connection. Provide anchor bolts of size required for connecting base to concrete foundations.

1. Internal Frames: Manufacturer's standard internal steel framing system and anchorage, modified as required for Project requirements. Provide welded construction. Cut, drill, and tap units to receive hardware, bolts, and similar items.

    a. Hot-dip galvanize steel framing system after fabrication according to ASTM A123/A123M.

2.7 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Verify that sign-support surfaces are within tolerances to accommodate signs.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

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

3.2 INSTALLATION

A. General: Install signs using installation methods indicated and according to manufacturer's written instructions and approved Shop Drawings.

1. Install signs level, plumb, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign components are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING PYLONS

A. Vertical Tolerance: Install pylons plumb within a tolerance of 1/16 inch in 3 feet.

B. Attachment with Preset Anchor Bolts: Set pylon base in position over anchor bolts projecting from concrete foundation, shim and support pylon to prevent movement, place washers and nuts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

C. Attachment with Drilled-in-Place Anchor Bolts: Set pylon base in position over concrete foundation, locate and drill anchor holes, shim and support pylon to prevent movement, place washers and anchor bolts, and tighten. Fill shim space with nonshrink, nonmetallic grout, mixed and placed to comply with manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 102800- TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes the following, where scheduled:

1. Public-use washroom accessories.
2. Custodial accessories.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Samples: Full size, for each exposed product and for each finish specified.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Source Limitations: Obtain accessories from single source from single manufacturer.

B. Provide accessories as scheduled on Drawings or comparable products by one of the following:

1. ASI.
2. Bobrick.
3. Bradley.

C. Owner-Furnished Materials: As scheduled on Drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

D. 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.

E. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 PREPARATION

A. Confirm location of accessories and provide sufficient blocking to anchor accessories securely in place. Where indicated, also provide blocking for future installation of accessories.

3.2 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, when tested according to ASTM F446.

3.3 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 instructions.

END OF SECTION

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets and wall mount brackets for fire extinguishers not located in fire-protection cabinets.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed and semirecessed method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

D. 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.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 FIRE-PROTECTION CABINET (FEC)

A. Cabinet Type: Suitable for fire extinguisher.

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

a. Babcock-Davis.
b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
c. Larsen's Manufacturing Company.
d. Nystrom, Inc.
e. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Aluminum sheet.

F. Door Material: Aluminum sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

J. 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: Red.
        4) Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: Match Architect's sample.

2. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

    a. Finish: Clear anodic.

3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 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. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. 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 thick.
2. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 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 unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 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

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 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 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

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

a. Babcock-Davis.
b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
c. Larsen's Manufacturing Company.
d. Nystrom, Inc.
e. Potter Roemer LLC; a Division of Morris Group International.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

1. Application: Typical, where fire extinguisher is indicated.

C. Clean-Agent Type in Aluminum Container: UL-rated 5-B:C, 5-lb nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

1. Application: In locations with computers, servers, or other sensitive equipment.

2.3 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. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine 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.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION

SECTION 107344 - TRANSPORTATION STOP WINDSCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular aluminum wind screens.

B. Related Sections Include the Following:

1. Section 055000 "Metal Fabrications" for windscreen supports.
2. Section 084113 "Aluminum-Framed Entrances and Storefronts" for Contractor's option to provide fabricated windscreen of storefront components. Delegated design as specified in this section is required for storefront construction.
3. Section 088000 "Glazing" for laminated glass for windscreens,

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for windscreens.

B. Shop Drawings: For windscreens. Include plans, elevations, sections, details, and attachments to other work.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates. Include location, diameter, and projection of anchor bolts required to attach windscreens to concrete bases. Indicate post reactions at each location.

C. Delegated-Design Submittal: For windscreen, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples: For each type of exposed finish in manufacturer's standard sizes.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For anchors, from ICC-ES.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For windscreens to include in maintenance manuals.

1.5 COORDINATION

A. Cast-in Anchorage: Coordinate installation of anchorages for windscreens. Furnish sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in

concrete bases. Include setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair finish or replace windscreens that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Windscreens shall withstand the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Design Loads: As indicated on Drawings.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. 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, ambient; 180 deg F, material surfaces.

C. Safety Glazing Products: Category II materials complying with testing requirements in 16 CFR 1201.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of SGCC or another certification agency acceptable to authorities having jurisdiction.

2.2 MODULAR ALUMINUM WINDSCREENS

A. Fabricate windscreens as an integrated set of modular components ready for assembly on Project site.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be able to fabricate windscreens to be incorporated into the Project include, but are not limited to, the following:

1. Brasco,
2. Panelbuilt,
3. Vestil Manufacturing Co.

C. Structural Framework: Fabricated from manufacturer's standard 2.5-by-2.5-by-0.125-inch aluminum tubing, channel, angle, or tee extrusions. Connect framework with exposed mechanical fasteners.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

F. Post Bases: Externally adjustable, flanged, aluminum sleeves; minimum 3-inch vertical adjustment. Include shims for leveling.

G. Anchorage: Cast-in-place anchor bolts, fabricated from stainless steel, with allowable load or strength design capacities calculated to be greater than or equal to the design load.

H. Materials:

1. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

a. Sheet: ASTM B209.
b. Extruded Shapes: ASTM B221.

2. Steel Structural Tubing: ASTM A500/A500M, Grade B.

I. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including concrete bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.

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.

3.2 INSTALLATION

A. Install windscreens according to manufacturer's written instructions and approved Shop Drawings.

B. Set windscreens plumb and aligned with full bearing on concrete bases.

C. Fasten windscreens securely to concrete base with anchorage indicated.

3.3 ADJUSTING

A. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 112217 – BULLET-RESISTANT TELLER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bullet-resistant deal trays.
2. Bullet-resistant barrier system.

B. Related Sections include the following:

1. Section 088853 "Security Glazing" for glass-clad polycarbonate used in barrier systems.
2. Section 092900 "Gypsum Board" for bullet-resistant panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For teller and service equipment.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For glass-clad polycarbonate.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each product indicated as ballistics resistant, for tests performed by a qualified testing agency.

1.4 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance, UL 752: Listed and labeled as level indicated when tested according to UL 752.

2.2 DEAL TRAYS

A. Welded 18-gauge stainless steel deal tray, designed for recessed installation in counter with concealed fasteners, inaccessible after installation, complying with level 3 per UL 752.

B. Basis of Design: Provide ballistic recessed currency tray, model TSS Bullet Trap Recessed Currency Tray or comparable product by one of the following:

1. Creative Industries, Inc.
2. C.R. Laurence Inc.
3. Total Security Solutions
4. U. S. Bullet Proofing.

2.3 BULLET-RESISTANT BARRIER SYSTEM

A. Barrier System: Glass-clad polyurethane panels, fin-supported or set into aluminum channels with minimal framing to keep sight lines open.

B. Basis of Design: TSS Secure Sound System or comparable product by one of the following:

1. Bullet Guard.
2. C.R. Laurence Inc.
3. North American Bullet Proof.
4. Total Security Solutions
5. U. S. Bullet Proofing.

C. Ballistic Resistance: Level 3 per UL 752.

D. Glazing Channels: Extruded aluminum.

E. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.4 MATERIALS

A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

B. Aluminum Extrusions: ASTM B221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.

C. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

2.5 FABRICATION

2.6 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 teller and service equipment from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of teller and service equipment.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

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

3.2 PREPARATION

A. Prepare recesses for recessed deal trays.

3.3 INSTALLATION

A. Install bullet-resistant teller equipment in accordance with manufacturers' recommendations and approved Shop Drawings.

B. Install deal tray recessed into counter where indicated.

C. Erect bullet-resistant barriers in accordance with manufacturer’s written recommendations and approved Shop Drawings.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as teller equipment are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Clean glass promptly after installation. Comply with manufacturer’s recommendations.

END OF SECTION

SECTION 123661 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop and windowsill materials.

B. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops and windowsills by field measurements before windowsill fabrication is complete.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops and windowsills or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As indicated by manufacturer's designations.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front: Straight, slightly eased at top, with 1-inch nosing.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 3/4-inch-thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch-thick, 4-inch-high solid surface material.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material windowsills and conditions under which windowsills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of windowsills.

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

3.2 INSTALLATION

A. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

B. Bond joints with adhesive and draw tight as windowsills are set. Mask areas of windowsills adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in windowsill edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.

C. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

SECTION 133100 – FABRIC STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-engineered Tensioned Fabric Structure.

1.2 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation slab and/or foundation. Anchor rod installation, grouting of base plate, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fabric structure including, but not limited to, the following:

a. Condition of foundations and other preparatory work performed by other trades.
b. Structural load limitations.
c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
d. Required tests, inspections, and certifications.
e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

1.4 ACTION SUBMITTALS

A. Product Data: For each type component of fabric structure.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

B. Shop Drawings: Indicate components by others. Include full canopy plan, elevations, sections, details and the following:

1. Anchorage Plans: Submit anchor bolts or rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach canopy to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of framing. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
3. Layout of tensioned fabric: Indicate seam arrangement.

C. Samples for Initial Selection: For units with factory-applied finishes and fabric.

D. Samples for Verification: For fabric.

E. Delegated-Design Submittal: For fabric structure.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

1. Include references for five previous project similar in design and extent to that indicated for this Project and erected within the past three years.
2. Physical address of manufacturing facility.

B. Welding certificates.

C. Manufacturer's Certificate: Indicating materials comply with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sole Source: Tensioned fabric structure shall be designed, fabricated and erected by a single entity. Primary paint materials shall be obtained from a single manufacturer. Secondary materials shall be those recommended by the primary manufacturer.

1. Basis of Design: Provide tensioned fabric structure by BirdAir or approved substitute.
Birdair, Inc.6461 Main Street, Amherst, New York 14221 USA
Phone (716) 633-9500 Fax (716) 633-9850
Sales@Birdair.com Web Site www.birdair.com

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a tensioned fabric structure capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fabric structure.

B. Structural Performance: Fabric structure shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.

C. 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: 120 deg F, ambient; 180 deg F, material surfaces.

D. Fire Performance: For Fabric:

1. Burning Characteristics per ASTM E84.

a. Flame Spread: 5 max.
b. Smoke Generation (Tunnel Test): 20 max.

2. Fire Resistance of Roof Coverings (ASTM E108).

a. Burning Brand: Class A

3. Incombustibility of Substrates (ASTM E136)

a. Substrate Noncombustible: Pass

4. Flame Resistance (NFPA 701 Small Scale, UL 94).

a. Flame Out: 1 second after
b. Char Length: 0.25-inch max.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Materials:

1. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
3. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B, structural tubing.
4. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

5. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts.

a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

6. Threaded Rods: ASTM A36/A36M.

a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

C. Finish: High performance organic coating.

2.5 FABRIC

A. Fabric: Polytetraflourethylene (PTFE) coated woven fiberglass. Fabric shall be the product of a single manufacturer.

B. Physical Characteristics: The following indicates a range of physical properties typical of PTFE Architectural Fabrics. The determination of specific characteristics and selection of a fabric shall be derived from project engineering by the Project Engineer

1. Coated Fabric Weight (oz./sq. yd.): 24 min. to 45.5 nom. (ASTM 4851)
2. Thickness (mils): 18 min. to 36 nom. (ASTM 4851)
3. Strip Tensile (lbs./in., avg.):

   a. Dry, Warp 520 min. to 975 min. avg. (ASTM 4851)
   b. Dry, Fill 380 min. to 900 min. avg. (ASTM 4851)

4. Strip Tensile, After Crease Fold; (lbs./in., avg.):

   a. Dry, Warp 375 min. to 760 min. avg. (ASTM 4851)
   b. Dry, Fill 350 min. to 735 min. avg. (ASTM 4851)

5. Trapezoidal Tear (lbs./in., avg.):

   a. Warp 35 min. to 95 min. avg. (ASTM 4851)
   b. Fill 35 min. to 120 min. avg. (ASTM 4851)

6. Solar Transmission (%): 7 to 22 nom. (ASTM E424)
7. Solar Reflectance (%): 70 to 73 nom. (ASTM E424)

C. Materials.

1. Base Fabric: The yarns used shall be free of broken fibers and fully suitable for coating. The fabric shall be woven with uniform tension and crimp in the warp and fill yarns and free of defects deleterious to the coating process.
2. Fluorocarbon Coatings: The coating materials shall be fluorocarbon resins formulated specifically for architectural applications. These materials shall be applied to form a weatherized barrier between the fiberglass yarns and the environment. The bulk of the coating shall be formulated dispersions of PTFE fluoropolymer resin and additives to enhance abrasion and tear resistance, impart pigmentation, or modify solar transmission. The additives shall not constitute more than 20% by weight of the total coating or 25% by weight of any individual layer. The surface shall be totally a fluoroethylenepropylene ("FEP") resin to facilitate heat welding.
3. After weaving, the base fabric shall be cleaned and primed to achieve optimum mechanical properties of the coated fabric. The coating, described above, shall be virtually free of mud cracks and pinholes. The coating shall be applied evenly to both sides of the fabric and the FEP fluorocarbon resin topcoat shall be of sufficient thickness to permit proper heat fusion of joints with the recommended die pressure and temperature.

2.6 CABLES AND END FITTINGS

A. Structural wire rope cables: ASTM A603.

B. Structural strand cables: ASTM A586.

C. Cables shall be coated to "Class A" zinc coating throughout except where in contact with fabric. Cables in contact with the fabric shall be white PVC coated.

2.7 ALUMINUM CLAMPING SYSTEM

A. Structural aluminum clamping systems: ASTM alloy 6061-T6.

B. Bent plates: ASTM alloy 6061, heat-treated to T6.

C. Structural "U straps": Stainless steel, Type 316.

D. Structural sheet aluminum: ASTM alloy 5052-H32.

E. Non-structural sheet aluminum: ASTM alloy 1100 series 4.

2.8 FASTENERS

A. General: Provide fasteners used to secure clamp systems to curbs and cables, assemblage of clamp systems, and other fasteners as required to complete the work specified herein.

B. Materials.

1. Bolts and studs: Stainless steel, ASTM F593, Type 304.
2. Nuts: Stainless steel, ASTM F594, Type 316.
3. Washers shall be plain, narrow, and conform to AISI Type 18-8.

    a. All clamping systems subjected to relative movement between clamping and curb shall receive a split-ring lock washer conforming to AISI Type 18-8.

4. Unless otherwise specified on the drawings, all other bolts and nuts shall conform to ASTM A307-76B, zinc plated to conform to ASTM B633 Class Fe/Zn 8 type III.

2.9 GASKETS

A. Sponge Neoprene Gasketing:

1. All sponge neoprene shall be of a cellular elastomeric compound of a firm grade, which has been manufactured in pre-formed shapes for use as gasket and sealing material, as specified in ASTM specification C509.
2. Cellular elastomeric materials furnished to this specification shall be manufactured from natural or synthetic rubber, or mixtures of these, with added compounds of such nature and quality that, with proper curing, the finished product will comply with this specification.
3. The cured compounds shall be suitable for use where resistance to sunlight, weathering oxidation, and permanent deformation under load are of prime importance.

4. The manufacturing process shall be such as will ensure a homogeneous cellular material free of defects that may affect serviceability.
5. The physical characteristics of the neoprene must meet or exceed ASTM C509, "Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Materials."

f. Certification of material shall be provided that conforms to ASTM C509.

B. Dense Neoprene Gaskets

1. All neoprene material shall conform to ASTM D 2000M hardness Grade 60. The material shall be homogenous, free from defects and shall be compounded and cured to meet the requirements specified herein.
2. All neoprene shall be non-staining formulation and shall consist of at least 50% by weight of basic rubber hydrocarbon. Material shall not contain crude or reclaimed rubber.
3. The physical characteristics of the neoprene must meet or exceed the following physical test requirements when tested using the standard ASTM test slab can compression set plug (or approved equal):

PROPERTY	ASTM TEST METHOD	UNITS
Shore A Durometer	D 2240	55 – 65
Tensile Strength (Min.)	D 412	1,100 PSI
Percent Elongation (Min.)	D 412	300%
Percent Compression Set (Max.)	D 395, Method B, 22 hrs at 212°F	35%
Heat Aging, Change from Original Properties:	D 573, 70 hrs @ 212°F	
Hardness Change (Max.)		+15 Points Shore A
Tensile Strength (Max.)		-15%
Elongation Change (Max.)		-40%
Flame Resistance		Must Not Propagate Flame
Temperature Range		-30°C to 100°C
Ozone Resistance	D 1171, Method A, 72 hrs @ 38°C and	0 mPa Ozone
Resistance to Oil Aging:	D 471, 70 hrs @ 212°F Immersion in ASTM Oil No. 3	
Tensile Strength (Max.)		-70%
Elongation (Max.)		-55%
Volume Change (Max.)		+120%

2.10 FABRICATION

A. Cables:

1. Cables that are designated to be prestretched shall be prestretched per ASTM A603 for wire rope and ASTM A586 for structural strand. Cables of the same type shall have the same modulus of elasticity.
2. All cables shall be manufactured to the following length tolerances at 70 degrees Fahrenheit (23 degrees Celsius):

a. Length < 70 feet (213 meters) ¼ inch (6.4 mm)
b. Length 70 to 270 feet (32.3 to 82.3 meters) 0.03% of length

c. Length > 270 feet (82.3 meters) 1 inch (25.4 mm)

3. Cables shall have a continuous longitudinal paint stripe (¼ inch wide max.) along their top surface unless noted otherwise.
4. Index markings shown shall be a circumferential paint stripe (¼ inch wide max.).
5. All cables and end fittings shall be delivered clean and dry.
6. All swaged and speltered fittings shall be designed and attached to develop the full breaking strength of the cable. Thimble end fittings shall develop a minimum of 90% of the cable breaking strength.
7. Swaged end fittings, pins, nuts, and washers shall be hot dip galvanized per ASTM A153. Any damage to the zinc coating shall be cleaned and painted with a gray zinc-rich paint per ASTM A780.
8. Speltered end fittings shall be hot dip galvanized per ASTM A153. Any damage to the zinc coating shall be cleaned and painted with a gray zinc-rich paint per ASTM A780.

B. Aluminum:

1. Fabricated aluminum shall have no sharp edges.
2. Stamp all parts with the appropriate mark number.
3. All fabricated aluminum shall be free of oil, grease, and machining chips.
4. Tolerances shall be as follows:

a. Cross sectional dimensions +/- 10%, 0.03-inch (0.8 mm) max.
b. Bolt hole locations +/- 1/32 inch (0.8 mm)
c. Overall length +/- 1/16 inch (1.6 mm)

5. All welded joints shall conform to AWS D1.2.

C. Steel Frame:

1. General: All members, when finished, shall be true and free of twists, bends, and open joints between the component parts. Members shall be thoroughly straightened in the shop by methods that will not injure them, before being worked on in any way.

a. Properly mark materials, and match-mark when directed by the Subcontractor, for field assembly.
b. Grind all edges and corners that could contact fabric to a minimum 1/16” (1.6mm) radius.

2. Connections.

a. Connections shall be as indicated on the drawings. When details are not shown, the connections shall conform to the requirements of the AISC.
b. Provide high-strength threaded fasteners for all structural steel bolted connections, unless noted otherwise.
c. Combination of bolts and welds in the same connection are not permitted, unless otherwise detailed.
d. Welded Connections: in accordance with AWS D1.1.

3. Oxygen Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. Alternatively, an unguided torch may be used provided the cut is not within 1/2 inch of the finished dimension and the final removal is completed by chipping or grinding

to produce a surface quality equal to that of the base metal edges. The use of oxygen-cut holes for bolted connections or pin connections will under no circumstances be permitted, and violation of this clause will be sufficient cause for the rejection of any pieces in which oxygen-cut holes exist.

4. Tolerances: All tolerances shall be as per the AISC "Code of Standard Practice for Steel Buildings and Bridges" unless otherwise indicated. Limit variation in straightness to (member length)/960 measured in any direction for all members.

D. Fabric Panels: Fabricate panels such that splices, if any, are patterned into a symmetrical and repetitive geometric arrangement within the assembly, as shown on the shop drawings and, where feasible, hidden by structural members. No shop patches are permitted.

1. Fabricated joints shall have a minimum of 90% of the total strength of the coated membrane in strip tensile testing. All structural joints shall be fused in accordance with industry standards and shall maintain the integrity of the coating. PTFE-coated woven fiberglass membranes shall be heat-sealed only.
2. Biaxial Test: At least one (1) representative sample of the outer membrane shall be biaxially test loaded. Membrane compensation in patterning shall be based upon the results of the biaxial test loading.

2.11 ALUMINUM FINISH

A. Finish: Clear anodized per MIL-A-8625C Type 2, Class 1 OR

B. Polyester thermosetting powder coating with a tri-glycidyl isocyanurate (i.e. TGIC) curing agent/hardener per American Architectural Manufacturers Association (AAMA) 2603 to a thickness of 3 mils, white in color.

2.12 STEEL FINISH

A. Surface Preparation: SSPC-SP-10, after all fabrication operations such as machining and welding are complete.

1. Protect all drilled and tapped holes and/or threaded studs prior to painting such that all bolted connections can be made without having to first cleaning threads.
2. Allow no more than eight hours between surface preparation and application of the prime coat.

B. Paint System: Three-Coat; Epoxy-Polyurethane

1. Prime Coat: Zinc-rich primer complying with SSPC paint specification No. 20.

a. Basis of Design: International Paint Interzinc 315.
b. DFT: 2.5-3 mils.

2. Intermediate Coat: Two-component high build epoxy.

a. Basis of Design: International Paint Intergard 475HS.
b. DFT: 4-6 mils.

3. Prime Coat: High-build polyurethane complying with SSPC paint specification No. 36.

a. Basis of Design: International Paint Interthane 870.
b. DFT: 4-5 mils.

C. Color: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and fabric structure manufacturer's tolerances.

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

3.2 ERECTION OF STRUCTURAL FRAMING

A. Erect fabric structure according to manufacturer's written instructions and approved Shop Drawings.

B. Do not field cut, drill, or alter structural members without written approval from fabric structure manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Erection of Structural Steel: Erect structural elements such that the position of member working points, including cantilevered members, shall not vary more than 1 inch in any direction either individually, or cumulatively across a shipping piece from the theoretical dimensions to which structure was engineered and fabricated. This includes but is not limited to: cable connection points, membrane panel edges, membrane bearing locations, intermediate splice points of field-spliced members, hardware connections, weldments and their anchorages.

1. The cumulative effect of dimensional steel discrepancies shall be such that the distance between membrane panel support points does not vary more than 1” (25mm) from the theoretical dimension within each membrane panel.
2. All steel structures that support tensioned membrane must maintain an uninterrupted drainage path and a minimum constant slope of 5 degrees from all points of the membrane.

E. Accurately align steel before making permanent connections.

F. Erection tolerances: As specified in the AISC “Code of Standard Practice for Steel Buildings and Bridges,” including those related to placement of anchor bolts, unless otherwise indicated.

G. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these specifications, the provisions of the more stringent shall govern.

3.3 FABRIC INSTALLATION

A. Install fabric in accordance with manufacturer’s written instructions, tensioning as required to meet performance requirements.

1. Patching and repairs: Install panels to limit abrasion, cuts and tears.
2. Limitation: No more than one field patch in 2000 sq. ft. shall be allowed, and no more than one field patch per panel, and no more than 5 field patches in the entire Work is permitted.
3. Patch small, damaged areas, maximum dimension in any direction 4 in., in the fabric. With circular patch.
4. All field patches shall be executed to achieve 100% of the virgin coated membrane's strength properties.

3.4 DEMONSTRATION AND TRAINING

A. Train Owner's maintenance personnel in the use of the repair material.

3.5 CLEANING AND PROTECTION

A. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing touch up finish coats as required to restore finish.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."

END OF SECTION

SECTION 22 05 00 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.

B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Plumbing work shall comply with applicable inspection services:
1. Underwriters Laboratories
2. National Fire Protection Association
3. State Health Department
4. Local Municipal Building Inspection Department

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that has served their Owners satisfactorily for not less than three (3) years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimums for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

B. As-Built drawings should indicate the following information as a minimum:
1. Indicate all addendum changes to documents.
2. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
3. Indicate exact location of all underground plumbing and flow line elevation.
4. Indicate exact location of all underground plumbing piping and elevation.
5. Indicate exact location of all underground electrical raceways and elevations.
6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
7. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
9. Exact location of all electrical equipment in and outside of the building.
10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
12. Cloud all changes.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient

time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for one (1) year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three (3) copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

1.17 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.18 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

C. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.19 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.20 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing, adjusting, and balancing of equipment.

B. Representative shall make written report of observations and recommendations to Architect / Engineer.

1.21 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

1.22 ELECTRICAL PROVISIONS OF PLUMBING WORK

A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.

B. Types of work normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
   1. Motors for mechanical equipment.
   2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
   5. Wiring of all related circulating water system chemical treatment devices.
      a. Low voltage electric contacting water meter
      b. Solenoid valve/blow-down assembly

C. Refer to Division 23 Controls Sections for related control system wiring.

D. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment, junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

E. Verify voltage on electrical plans.

1.23 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances

B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

C. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.24 CONTRACTOR SUBMITTAL AND SHOP DRAWING RESPONSIBILITES

A. Review submittals prior to transmittal.

B. Determine and verify:
   1. Field measurements.
   2. Field construction criteria.
   3. Manufacturer's catalog numbers.
   4. Conformance with requirements of Contract Documents.

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
   1. Proper sizes and capacities.
   2. That the item will fit in the available space in a manner that will allow proper service.
   3. Construction methods, materials and finishes.

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 VANDAL RESISTANT DEVICES

A. Provide a handle for each loose keyed operated valve and hose bibb on the project.

B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner two (2) suitable tools for use with each type of fastener used.

C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the plumbing systems.
   1. Provide the training during the Owner's regular working day.
   2. The Instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems and with the project.

B. Time to be allocated for instructions.
   1. Minimum of 4 hours dedicated instructor time.
   2. 2 hours on each of 2 days.

C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
   1. One copy to the Owner.
   2. One copy to the Architect/Engineer.

D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform

whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.5 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.6 OPERATION AND MAINTENANCE MANUAL

A. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
   a. Contractor, name of responsible principal, address and telephone number.
   b. A list of each product required to be included, indexed to content of the volume.
   c. List with each product, name, address and telephone number of:
      1) Subcontractor or installer.
      2) Maintenance contractor as appropriate.
      3) Identify area of responsibility of each.
      4) Local source of supply for parts and replacement.
   d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
   a. Include those sheets pertinent to the specific product.
   b. Annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.
3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems.
      2) Control and flow diagrams.
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.

4. Copy of each warranty, bond, and service contract issued.

   a. Provide information sheet for Owner’s personnel, giving:
      1) Proper procedures in the event of failure.
      2) Instances that might affect validity of warranties or bonds.

5. Shop drawings and product data, as specified.

B. Sections for Equipment and Systems:
1. Content for each unit of equipment and system as appropriate.
   a. Description of unit and component parts.

1) Function, normal operating characteristics, and limiting conditions.
2) Performance curves, engineering data and tests.
3) Complete nomenclature and commercial number of replaceable parts.

b. Operating procedures:
1) Start up, break-in, routine and normal operating instructions.
2) Regulation, control, stopping, shut down and emergency instructions.
3) Summer and winter operating instructions.
4) Special operating instructions.

c. Maintenance procedures:
1) Routine operations.
2) Guide to trouble-shooting.
3) Disassembly, repair and reassembly.
4) Alignment, adjusting and checking.
5) Routine service based on operating hours.

d. Servicing and lubrication schedule. List of lubricants required.
e. Manufacturer's printed operating and maintenance instructions.
f. Description of sequence of operation by control manufacturer.
g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
1) Predicted life of part subject to wear.
2) Items recommended to be stocked as spare parts.

h. As installed control diagrams by controls manufacturer.
i. Complete equipment internal wiring diagrams.
j. Schedule of filters for each air handling system.
k. Schedule of belts for each item of equipment.
l. Each Contractor's coordination drawings.
m. As installed color coded piping diagrams.
n. Charts of valve tag number, with location and function of each valve.
o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
p. Other data as required under pertinent sections of the specifications.

2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

END OF SECTION

SECTION 211000 - PLUMBING PIPING & FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install plumbing piping in buildings and site. Insulate all hot domestic water piping above grade. All domestic water products including, but not limited to, pipe, fittings, and fixtures shall be 'Lead Free'

B. Cellular core PVC pipe is not permitted.

C. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 JOB REQUIREMENTS

A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND FITTINGS

A. Below Slab on Grade Piping for Water Entries: provide ASTM B88 and ANSI/NSF Standard 61 Type K annealed tempered (soft) seamless copper water tube. No joints below slab entries.

B. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.

C. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.

D. Air Chambers. Provide a minimum 18-inch long air chamber, of the same size and connecting pipe material at each single lavatory, sink, drinking fountain or fixture that does not have a quick-closing valve or electrical, pneumatic, spring loaded type, or flush valve. Air chambers to be used for remote fixtures and not mixed with water hammer arrestors at group toilets.

E. Water Hammer Arrestors. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.

F. Insulation. 3/4" Heavy density, dual temperature fiberglass insulation with factory applied, all

service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips.

G. PEX system must be listed ASTM F876/F877. Tubing shall be listed PEX 5006 for chlorine resistance for continuous usage up to 140°F. All tubing installed in return air plenums shall be listed ASTM E84. The listing may be for the tubing itself or for the tubing including insulation to achieve the listing. The fittings shall be of the same manufacturer as the tubing and the installation instructions of the manufacturer shall be strictly adhered to. Viega PureFlow or Uponor Systems only.

2.2 SANITARY SEWER PIPE AND FITTINGS

A. Above Slab Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

B. Above Slab Pipe in Return Air Plenum and Open Ceiling Area:
1. Service weight cast iron hub and spigot pipe and fittings.
2. Compression type, with neoprene gaskets shall conform to ASTM C-564.
3. Pipe shall conform to requirements of ASTM A74.

C. Below Slab on Grade Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

2.3 SANITARY VENT PIPE AND FITTINGS

A. Above Slab Piping in Walls: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

B. Below Slab on Grade Piping: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82 and NSF 14.

2.4 ACCEPTABLE FIXTURE MANUFACTURERS

A. Vitreous China:
1. American Standard.
2. Kohler.
3. Toto
4. Zurn

B. Plumbing Faucets:
1. American Standard.
2. Chicago.
3. T&S Brass.
4. Zurn.
5. Symmons.
6. Speakman
7. Moen Commercial
8. Delta Commercial

C. Supports and Carriers:
1. Zurn.
2. J.R. Smith.

3. Wade.
4. Josam.
5. Watts
6. MIFAB

D. Flush Valves:
1. Sloan
2. Zurn
3. Moen Commercial

E. Supplies, Stops and Chrome Plated Tubular Brass:
1. McGuire
2. Kohler
3. Chicago
4. Zurn

F. Water Closet Seats:
1. Beneke
2. Church
3. Olsonite
4. Bemis
5. Centoco

G. Electric Drinking Fountains:
1. Halsey Taylor
2. Elkay
3. Oasis
4. Haws
5. Acorn Aqua

H. Floor Drains:
1. Zurn
2. J.R. Smith
3. Josam
4. Wade
5. Watts
6. Sioux Chief
7. MIFAB

I. Cleanouts:
1. Zurn
2. J.R. Smith
3. Josam
4. Wade
5. Watts
6. MIFAB

J. Mop Sinks:
1. Crane Fiat
2. Stern Williams
3. Acorn
4. CECO

K. Thermostatic Mixing Valves
1. Lawler
2. Symmons
3. Leonard
4. Powers
5. Holby
6. Bradley
7. Acorn

L. Shock Arrestors:
1. Precision Products
2. Sioux Chief
3. MIFAB

M. Backflow Preventors
1. Watts
2. Febco
3. Wilkins

N. Hose Bibbs
1. Chicago
2. Josam
3. Woodford
4. Zurn
5. J.R. Smith
6. Wade
7. MIFAB

O. Wall Hydrants
1. Woodford
2. MIFAB
3. Zurn
4. J.R. Smith
5. Josam
6. Wade

PART 3 – EXECUTION

3.1 SANITARY INSTALLATION

A. Give horizontal pipe grade of ¼-inch per foot where possible, but not less than 1/8 inch per foot unless otherwise shown.

A. Above ground installation in the horizontal position shall be supported at every hub. Hangers to be placed within 18” of hub or coupling. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15’-0”.

B. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer’s recommendations and applicable standards.

C. All PVC underground shall be installed in accordance with ASTM D2321.

D. Offsets and Fittings.
1. Use reduction fittings to connect two pipes of different diameter.
2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eights-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.
3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.

E. Hub Drains. Install hub drains where indicated, with the top of the hub 1/2 above the finished floor, unless otherwise indicated on the drawings.

F. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.
1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
2. Provide cleanouts where soil lines change direction, every 50 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of fixture.
4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.

G. Floor Drains. Locate floor drains 1/2-inch below finish floor elevation unless otherwise shown.

H. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.

I. Flash the roof penetration with not less than 3 pounds per sq. ft. or 1.2 mm thick lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.

J. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan

3.2 DOMESTIC WATER PIPE INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufactured, for maintenance.

B. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be

supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.

C. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

D. Cover all domestic hot water piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3” wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with vapor barrier coating for chilled water piping applications.

3.3 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.4 SANITARY SEWER TESTING

A. Below Slab on Grade:
1. Test pipe below slab on grade before backfilling and connecting to city sewers.
2. Maintain not less than 10 foot of hydrostatic head for1 hour without a leak.
3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
6. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.

3.5 DOMESTIC WATER TESTING

A. Test under a cold water hydrostatic pressure per the State Plumbing Code and carefully check for leaks. Repair leaks and retest system until proven watertight and maintained for 6 hours.

B. Use only potable water for the test.

C. Perform the test before fixtures, faucets, trim or final connections are made to equipment.

D. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.

E. Do not insulate or conceal piping systems until tests are satisfactorily complete.

F. If any leaks or other defects are observed, suspend the test and correct the condition at once.

Repeat testing until leaks are eliminated and the full test period is achieved.

G. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.6 COPPER PIPE CORROSION PROTECTION

A. Provide plasti-sleeve 0.006 thick corrosion protection on the copper tube piping systems in the building slab, beneath the building slab, and/or buried. Route plasti-sleeve the entire length of below slab on grade copper tubing.

B. Extend the corrosion protection 6 inches above concrete slab on grade.

3.7 PLUMBING FIXTURE INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions.

B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.

C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.

D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibs, and where shown on drawings.

E. Remove piping and services roughed-in incorrectly and install correctly, without cost.

F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.

G. Coordinate with the Contractor for locations and service required for each plumbing fixture.

H. All floor drains and floor sinks shall have trap primer connections. Provide trap primer valves and 1/2-inch water line to each floor drain connection. Trap primer supply line shall have ball valve and Y strainer on inlet side of trap primer valve to facilitate cleaning.

I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.

3.8 STERILIZATION

A. Sterilize the water system with solution containing not less than 50PPM available chlorine. Allow chlorinating solution to remain in system for period of 8 hours (minimum). Have valves and faucets opened and closed several times during the period. After sterilization, flush the solution from the system with clean water until residual chlorine content is less than 0.2 parts per million.

END OF SECTION

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. This Work shall consist of furnishing all labor, materials, equipment, and incidentals required to remove and dispose of existing gravity sewer pipe if required, perform point
repairs, remove and replace repairs and install new gravity sanitary sewer lines and fittings.

1.3 ACTION SUBMITTALS

A. The Contractor shall submit to the Owner prior to receiving the Notice to Proceed at the pre-construction meeting, a list of materials to be furnished and the names of the suppliers.

B. The Contractor shall submit for approval, complete, detailed shop drawings of all pipe and fittings.

C. The Contractor shall submit and shall comply with the pipe manufacturer’s recommendations for handling, storing and installing pipe and fittings.

D. The Contractor shall submit pipe manufacturer’s certification of compliance with these Contract Documents.

E. Product Data: For the following:

1. Pipe and fittings.
2. Non-pressure and pressure couplings
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.

F. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

2. Show system piping in profile. Draw profiles to horizontal scale of not less than 1 inch equals 50 feet (1:500) and to vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

B. Product Certificates: For each type of pipe and fitting.

C. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 When a foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in the United States. Certification from any other source is not acceptable. Furnish copies of test reports to the Engineer for review. Cost of testing shall be borne by the Contractor.

2.2 Contractor shall provide sewer pipes with the inside diameter shown on the Contract Documents. Diameters shown on the Drawings and listed in the pay items represent the required inside diameters, regardless of pipe material.

2.3 When an item for gravity "Sewer Pipe" is included in the contract, the Contractor has the choice to select from the following list of pipe materials in accordance with the specified inside diameters:

- Less than 18” (inside diameter) – PVC and Ductile Iron

2.4 Contractor shall provide sewer pipes with the inside diameter shown on the Contract Documents. Diameters shown on the Drawings and listed in the pay items represent the required inside diameters, regardless of pipe material.

2.5 Plastic Pipe: Pipe may be any of the following types:

A. Polyvinyl Chloride (PVC) Pipe and Fittings: Polyvinyl chloride sewer pipe shall be green in color.

B. PVC for Direct Bury Application:
   1. Solid Wall PVC
      - Pipe shall be of solid-wall construction and be available in laying lengths not exceeding 20 feet.
      - Pipe 15" diameter or smaller shall conform to ASTM D 3034; pipe larger than 15" diameter shall conform to ASTM F 679.
      - Material for PVC pipe from 4” to 15” shall conform to the requirements of ASTM D 1784 for cell classifications 12454. Material for PVC pipe from 18” to 27” shall conform to the requirements of ASTM D 1784 for cell classifications 12364 or 12454. Maximum filler content shall be 10 percent.
      - All pipe shall have an SDR of 35 and a minimum pipe stiffness of 46 psi when tested in accordance with ASTM D 2412. Where pipe depth is greater than 12 ft., provide pipe in SDR 26 with minimum pipe stiffness of 115 psi.
      - Joints shall be an integral bell and spigot-type with solid cross section elastomeric or rubber gasket ring conforming to ASTM D 3212. Gaskets shall meet the requirements of ASTM F 477. Use elastomeric factory installed gaskets to make joints flexible and watertight. Lubricant for rubber-gasketed joints shall be water soluble, non-toxic, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets. The manufacturer shall test a sample from each batch conforming to the requirements of ASTM D 2444.
      - All sewer fittings and accessories shall conform to the requirements of ASTM F 1336 and ASTM D 3034 or ASTM F 679 and shall have bell and/or spigot compatible with pipe. The stiffness of the fittings shall not be less than the stiffness of the adjoining pipe.

2.6 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Lined and polyethylene-wrapped ductile iron pipe shall conform to AWWA C150 and C151, subject to the supplemental requirements in this Section. The pipe shall be of the diameter and class indicated, and shall be provided complete with rubber gaskets, specials, and fittings as required under the Contract Documents. Nominal pipe laying lengths shall be 20 feet.

B. Fittings shall be ductile iron conforming to the requirements of AWWA C153 or AWWA C110 and shall have a minimum pressure rating of 250 psi.

C. All pipe shall have a minimum pressure rating as follows, or higher ratings as indicated in the Contract Documents.

   1. For pipe sizes 4-12 inches, minimum pressure class shall be 350 psi.

D. The Contractor shall legibly mark specials 24-inches in diameter and larger in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

E. Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing on the Contract Drawings. The locations of correction pieces and closure assemblies are shown on the Contract Drawings. Any change in location or number of said items shall only be as accepted by the Engineer.

F. Interior Linings:

   1. Preparation: Brush-off blast cleaning conforming to SSPC-SP7.

2. Liner thickness: Minimum 40 mils, for pipe barrel interior.

3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.

4. Acceptable Lining Materials shall be Ceramic Epoxy: Protecto-401 by Induron Protective Coatings, Series 431 PermaShield by TNEMEC, PermoxCTF by Permite, or approved equal. Interior lining shall be applied in accordance with the manufacturer's recommendations.

5. Contractor shall seal cut ends, touch-up, or repair interior lignin in accordance with manufacturer's recommendations.

G. Buried Piping: –Provide polyethylene encasement unless otherwise specified or shown. Polyethylene sleeves or bags shall conform to the requirements of AWWA C105 and these specifications.

H. All buried piping, fittings, steel lugs, rods, brackets, clamps and other metal components shall be polyethylene encased.

I. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C151 except where modified by this Section. The pipe and fittings shall be of the diameter and class indicated.

J. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required. Mechanical and push-on joints including accessories shall conform to AWWA C111.

K. Flanged joints shall conform to AWWA C115. Flanged joints shall not be used in underground installations except within structures. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe. All flanged piping shall be a thickness Class 53, per AWWA C115. All flanged joints shall be furnished with a minimum 1/8-inch, thick red rubber or styrene butadiene rubber gasket. The bolts and nuts shall be teflon coated high strength low alloy steel per AWWA C111 with head and nut dimensions as specified in ANSI B18.2. For bolts of 1-3/4-inches in diameter and larger, bolt studs with a nut on each end are recommended.

L. Restrained joints shall be commercially available units provided by American Ductile Iron Pipe, U.S. Pipe, or approved equal. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Under such circumstances, the Contractor may propose such devices provided the following conditions are met and the request is made as a substitution:

1. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of the pipe.

2. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the Owner that the installers are adequately trained in the installation of the units and that all warranties are in full affect for the project.

3. The devices shall be MegaLug Model 1100 as manufactured by EBAA Iron or approved equal.

M. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The Contractor shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.7 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
2. Horizontal type; with swing check valve and hub-and-spigot ends.
3. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
4. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.8 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

2. Top-Loading Classification(s): Light Duty, Medium Duty, and Heavy Duty.
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details to indicate general location and

arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Open Trench:
   1. Trenching construction consists of trench excavation, bedding, laying of pipe on grade, backfill, compaction, grading and incidentals in accordance with Baton Rouge Standard Specifications Section 801.

E. Pipe laying: Pipe shall be handled, stored, and laid in accordance with the manufacturer’s instructions and as specified as follows.
   1. During pipe laying, trenches shall be kept dry. After each day's operations, and at other times when pipe laying is discontinued for more than one (1) hour, ends of the pipe shall be capped or plugged until pipe laying is resumed.
   2. Pipe laying shall not advance backfilling by more than 100 feet without approval by the Engineer.
   3. The pipes and fittings shall be so laid in the trench that after the sewer is completed, the interior surface of the bottom thereof shall conform accurately to the line and grade shown in the Contract Documents. Pipe laying shall begin at downstream end of line. Bell or groove ends of pipe shall be placed facing upstream. Bell holes shall be excavated to assure that only the pipe barrel shall bear upon the trench bedding material. No blocking under the pipe will be permitted.
   4. Extreme care shall be used when handling and installing pipe and fittings. Under no circumstances shall pipe or fittings be dropped either into the trench or during unloading. The interior of the pipe shall be thoroughly cleaned of oil, dirt, and foreign matter, then closely inspected for damage to coatings, walls, bells, gaskets, and ovality, prior to installation. Nonconforming or damaged pipe, gaskets, or coatings shall not be installed.
   5. When necessary to cut and machine all pipe in the field, the appropriate tools as recommended by the pipe manufacturer, shall be used. A “full insertion mark” shall be provided on each field cut pipe end. Field-cut pipe shall be beveled with a beveling tool specifically made for the pipe material.
   6. The Contractor shall make every effort to conform to the line and grade of the plans. The grade shown on the Plans is that of the invert to which the Work must conform. The Owner reserves the right to make adjustments to the grades and slopes to fit actual field conditions.
   7. After completion of pipe installation, no sag in the line greater than the maximum allowed sag tolerances noted in the Standard Plan 802-01 shall be acceptable. Any section of pipe that does not conform to these specifications shall be replaced or relaid at the contractor’s expense.

F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe- jacking process of microtunneling.

G. Pipe Jointing: The jointing of the pipe shall be done in strict accordance with the pipe manufacturer's instructions and shall be done entirely in the trench. Joints and gaskets shall comply with Subsection 802-2 and the relative pipe material. Workmen who are certified by the pipe manufacturer to join the pipe shall only perform pipe jointing. They should perform the work

as follows:

1. Expend extreme care to keep the bells of the pipe free from dirt and rocks so joints may be properly assembled without overstressing the bells.
2. Provide lubricant, place and drive home newly laid sections. Use of backhoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by the Engineer.
3. Install pipe to “full insertion mark” where provided.

H. New Pipe-Existing Pipe Connections: Connections between existing and new pipe, with the exception of HDPE pipe, shall be jointed with non-shear repair couplings conforming to Rev. 7/2017 Page 4 ASTM C425 and ASTM C1173. The stainless steel shear rings and clamping bands used in conjunction with the molded rubber sleeve shall conform to ASTM A 240 Series. When using the non-shear repair coupling, the gap between the two pipes shall be no more than ¼”.

When non-shear repair couplings are not available for a particular size or material, connections between existing and new pipe shall be jointed using flexible elastomer couplings with a 300 stainless steel band for each end and adjusting screws capable of sustaining an applied torque in excess of 80 inch-pounds. When dissimilar pipe materials are joined, the Contractor shall use flexible couplings that are resistant to the corrosive action of the soils and sewage, and that provide a permanent watertight joint.

Connections between existing and new HDPE pipe shall be jointed with HDPE electrofusion couplings in accordance with subsection 1016-1.1.2. Prior to ordering materials, Contractor shall check existing pipe diameters and take care to provide matching pipe and coupling to make proper connection.

3.3 Acceptance Tests for New Pipe: Installed sewer lines shall pass one or more of the following tests performed by the Contractor as directed by the Engineer. Contractor shall perform the test in the presence of the Engineer or his representative. Contractor shall coordinate testing with surface restoration requirements of Section 4-5. Any removal or replacement of temporary or final surface restoration by the Contractor to investigate leaks shall be done so at no additional cost to the Owner.

A. Leakage Tests: Sewer lines shall be tested for leakage as follows:

1. Low Air Pressure Test - manhole to manhole reach of pipe for sewer pipe 36” in diameter and smaller; individual joints for sewer pipe larger than 36” in diameter
2. Infiltration Test - for sewer pipe greater than 36” in diameter with groundwater equal to or greater than 2 feet above top of pipe (with approval of Engineer).
3. Exfiltration Test - for sewer pipe greater than 36” in diameter with groundwater less than 2 feet above top of pipe (with approval of Engineer).

B. Low Air Pressure Test: This practice defines the proper procedures for acceptance testing of installed gravity sewer pipe using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test method, and minimum holding times. Applicable sections of ASTM F1417 shall also apply.

1. Only lines tested after backfilling to final grade will be considered for acceptability. Acceptance will be dependent on a passing test. However, the installer as a presumptive test to determine the condition of the line prior to backfilling may also use this test.

During sewer construction, all service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged to prevent air loss that could cause an erroneous air test result. It may be necessary and is always advisable for the Contractor to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps, and tie-rods or wire harnesses over the pipe bells.

2. Unless otherwise specified, the Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the Contractor shall be responsible for any necessary repair work on sections that do not pass the test at no additional cost to the Owner.
3. The Engineer shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. The Engineer will inform the Contractor regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test.
4. Ensure that all plugs are installed and braced to prevent blowouts. As an example of the hazard, a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24- inch plug by an internal pressure of 5 psig. The Contractor must realize that sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested while as pressure is maintained in the line.
5. Internal pressure of more than 9 psig shall not be permitted except for leak location equipment where the plugs are firmly tied together. Contractor should verify maximum allowable pressure recommended by pipe manufacturer.
6. Use either mechanical or pneumatic plugs. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor shall internally restrain or brace the plugs to the manhole wall as an added safety precaution throughout the test.
7. Air test gauges shall be laboratory-calibrated test gauges, and if required by the Engineer, shall be recalibrated by a certified laboratory prior to the leakage test. Rev. 7/2017 Page 7 Air gauges shall have a size and pressure range appropriate for the pipe being tested.
8. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not, at any time, exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)
9. To facilitate test verification by the Engineer, all air used shall pass through a single, above ground control panel. The aboveground air control equipment shall include a shut-off valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi. Two separate hoses shall be used to: 1) connect the control panel to the sealed line for introducing low-pressure air, and 2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.
10. If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.
11. After a manhole-to-manhole reach of pipe has been backfilled to final grade and compacted, prepared for testing, and a 24-hour waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.
12. The Contractor is advised to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with

the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

13. When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.
14. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. If the groundwater table is above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer, up to a maximum of 9.0 psig. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.
15. When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater backpressure), the air hose from the Rev. 7/2017 Page 8 control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average backpressure of any groundwater over the pipe). At a reading of 3.5 psig, timing shall commence with a stopwatch.
16. If the time shown for the designated pipe size and length (see Table 8-1 1.0 PSIG Air Test Pressure Drop) elapses before the air pressure drops 0.5 psig, the section undergoing test shall have passed. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop has not occurred. If the pressure drops 0.5 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
17. If the section fails to meet these requirements, the Contractor shall determine at their own expense the source, or sources, of leakage, and shall repair or replace all defective materials or workmanship to the satisfaction of the Engineer. The extent and type of repair, which may be allowed, as well as results, shall be subject to the approval of the Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

Pipe Diameter	Minimum Time Lapse (min:sec)							
Inch	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48

C. Infiltration Test: Where the natural groundwater is 24 inches or more above the top of a section of pipe, the Contractor shall measure the flow of water in the pipe and the rates of seepage and infiltration. Contractor shall measure the flow rate by using a calibrated weir. The Contractor shall leave the weir in the line until the flow rate has stabilized. The Contractor is responsible for verifying the groundwater level by providing sight gauges in manholes or digging test holes at suitable locations.

1. The total seepage and infiltration of groundwater as determined by the test shall in no

case exceed 50 gallons per 24 hours per inch-mile of pipe.

2. Make infiltration tests on all sewer construction before placing the lines in service and before making any connections to other sewers.
3. If the amount of infiltration into the sewer(s) is in excess of the maximum quantity specified above, then repair the joints, relay the sewer (if necessary), or perform other remedial construction, at the Contractor's expense, in order to reduce groundwater infiltration to within the specified limits.

3.4 Exfiltration Test: Where the groundwater is not 24 inches or more above the top of the pipe section being tested, the Contractor shall perform an exfiltration test.

A. The Contractor shall bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device. Insert a vent pipe 48 inches long in the stopper of the upper end of that section. Then fill the lower manhole with water, or add water until there is a minimum of 4 feet over the upper end; make certain that all air is forced out through the vent tube.

B. Contractor will measure the drop in the level of the water in the manhole due to exfiltration over a specific time, and calculate the water loss due to exfiltration. The total exfiltration shall not exceed that specified above for infiltration.

3.5 Mandrel Test: Pipe shall not exceed a deflection of more than 5%. Unless otherwise directed by the Engineer, after pipe has been backfilled for at least 30 days, a mandrel sized at 95% of the inside pipe diameter shall be pulled through pipe.

3.6 Smoke Test:

A. All new sewer lines including service laterals with diameters up to & including 15 inches shall be smoke tested prior to backfilling in accordance with Section 814.

B. At the discretion of the Owner, a final smoke test shall be performed a minimum of nine (9) months after final acceptance up to the end of the twelve (12) month warranty period.

C. Leaks detected during smoke testing must be repaired as part of the Work and shall be considered incidental to and included in the cost of Work.

3.7 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

B. Install combination horizontal and manual gate-type valves in piping and in manholes.

C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

3.8 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 223330 - ELECTRIC WATER HEATER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

A. Division 15 Mechanical:
   1. Domestic Water Piping.
   2. Mechanical Piping Insulation.
   3. Division 16 Electrical.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Lochinvar

B. State.

C. Rheem/Ruud

D. A. O. Smith

2.2 PRODUCTS

A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.

B. Provide a tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.

C. Furnish factory-assembled, integral units equipped as follows:
   1. Dip tube.
   2. Individually mounted thermostat at each element with a high temperature cutoff.
   3. Glass lined tank.
   4. Minimum R-16 insulation.
   5. UL rated.
   6. Heavy-duty, tank mounted, screw-in anode rod.

D. Provide low watt density elements having zinc-plated, copper sheathing and prewired leads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide at each heater an automatic temperature and pressure relief valve with rating matching or exceeding the energy input rate.

B. Pipe the discharge port to a point of visible and safe disposal required by codes and the drawings.

C. Contractor shall provide a temperature gauge at heater.

D. Install water heater in galvanized drain pan piped to floor drain or exterior. Provide ¾" outlet connection.

END OF SECTION

SECTION 230500 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.

B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.

B. Mechanical work shall comply with applicable inspection services:
1. Underwriters Laboratories
2. National Fire Protection Association
3. State Health Department

C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that has served their Owners satisfactorily for not less than three (3) years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimums for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. Where a conflict exists between specifications and drawings, the more stringent of the two shall apply. Request clarification from Architect / Engineer before proceeding.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.

1.7 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

A. Guarantee work for one (1) year from the date of substantial completion of the project. During

that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship.

1.11 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two (2) or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted seven (7) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 OPERATING TESTS

A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit three (3) copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples if requested.

1.17 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

C. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.18 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.19 BUILDING CONSTRUCTION

A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

1.20 ELECTRICAL PROVISIONS OF MECHANICAL WORK

A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.

B. Types of work normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
   1. Motors for mechanical equipment.
   2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
   4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
   5. Wiring of all related circulating water system chemical treatment devices.
      a. Low voltage electric contacting water meter
      b. Solenoid valve/blow-down assembly

C. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment, junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

D. Verify voltage on electrical plans.

1.21 PRODUCT DATA AND INSTALLATION INSTRUCTION

A. Submit only pages which are pertinent to the project. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances

B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

1.22 CONTRACTOR SUBMITTAL AND SHOP DRAWING RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements
2. Field construction criteria
3. Manufacturer's catalog numbers
4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
2. That the item will fit in the available space in a manner that will allow proper service
3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.23 TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

A. The outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings. The organization performing the work shall be a certified member in good standing of the (AABC) Associated Air Balance Council.

1.24 EARTHWORK

A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures

installed as part of mechanical work.

PART 2 – PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 OPENINGS

A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

A. Immediately prior to substantial completion of the project, replace air filters and strainers.

3.3 LUBRICATION, REFRIGERANT AND OIL

A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.

B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.

C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.

B. Pre-fabricated plastic pads shall be four-inch high, rounded edges, and UV resistant.

C. Concrete housekeeping pads shall be four-inch higher than grade with rounded edges. Concrete shall be 3,000psi. Refer to Div. 3 for more information.

3.5 EARTHWORK EXCAVATION AND BACKFILL

A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.

B. Cut the bottom of the trench or excavation to uniform grade.

C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.

D. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.

E. Backfill shall not be placed until the work has been inspected, tested and approved. Complete

backfill to the surface of natural ground or to the lines and grades shown on drawings. Outside building slab, driveway paving and except where special materials are requested, use suitable friable soils from other excavation as backfill material. Use select fill under building slab, paving and where indicated in Division 2. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.

F. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by the Owner/Architect.

3.6 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
   1. Provide the training during regular working day.
   2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.

B. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

D. Demonstrate equipment functions (both individually and as part of the total integrated system).

E. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

F. Submit a report within one week after completion of training. List time and date of each demonstration, time devoted to the demonstration, and a list of people present.

G. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

H. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.7 EQUIPMENT IDENTIFICATION

A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
   1. Designation approved by Architect/Engineer.
   2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
   3. Submit schedule of equipment to be included and designations.

B. Provide nameplates with ½-inch high letters and fastened with epoxy or screws.

3.8 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
   2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.9 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.10 INDOOR AIR QUALITY

A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.

B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.

C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.

D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.

E. Utilize manufacturer’s recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.

F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.

G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.

H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

3.11 TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

A. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction

deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of the deficiencies.

B. Verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. Perform the following TAB procedures in accordance with the AABC National Standards
   1. Diffusers, Registers and Grilles - Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
   2. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
   3. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
   4. DX Equipment: With each unit operating at near design conditions, measure and record the following:
      1. Manufacturer, model number, serial number and all nameplate data.
      2. Ambient temperature, condenser discharge temperature.
      3. Amperage and voltage for each phase.
      4. Tons of cooling.
      5. Verification that moisture indicator shows dry refrigerant.

C. The activities described in this section shall be recorded in report form to be provided individually bound, to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface"; a general discussion of the system, any abnormalities and problems encountered.

D. All measurements and recorded readings that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the firm.

3.12 OPERATION AND MAINTENANCE MANUAL

A. Content of Manual:
   1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
      a. Contractor, name of responsible principal, address and telephone number.
      b. A list of each product required to be included, indexed to content of the volume.
      c. List with each product, name, address and telephone number of:
         1) Subcontractor or installer.
         2) Maintenance contractor as appropriate.
         3) Identify area of responsibility of each.
         4) Local source of supply for parts and replacement.
      d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
   2. Product Data:
      a. Include those sheets pertinent to the specific product.
      b. Annotate each sheet to:
         1) Identify specific product or part installed.

2) Identify data applicable to installation.
3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner.

3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems.
      2) Control and flow diagrams.
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
4. Copy of each warranty, bond, and service contract issued.
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in the event of failure
      2) Instances that might affect validity of warranties or bonds.
5. Shop drawings and product data as specified.

B. Sections for Equipment and Systems:
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts.
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine and normal operating instructions.
      2) Regulation, control, stopping, shut down and emergency instructions.
      3) Summer and winter operating instructions.
      4) Special operating instructions.
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting.
      3) Disassembly, repair and reassembly.
      4) Alignment, adjusting and checking.
      5) Routine service based on operating hours.
   d. Servicing and lubrication schedule. List of lubricants required.
   e. Manufacturer's printed operating and maintenance instructions.
   f. Description of sequence of operation by control manufacturer.
   g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      1) Predicted life of part subject to wear.
      2) Items recommended to be stocked as spare parts.
   h. As installed control diagrams by controls manufacturer.
   i. Complete equipment internal wiring diagrams.
   j. Schedule of filters for each air handling system.
   k. Schedule of belts for each item of equipment.
   l. Each Contractor's coordination drawings.
   m. As installed color coded piping diagrams.
   n. Charts of valve tag number, with location and function of each valve.
   o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
   p. Other data as required under pertinent sections of the specifications.

2. Prepare and include additional data when the need for such data becomes apparent

during instruction of Owner's personnel.

3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications.
4. Provide complete information for products specified in Division 23.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

END OF SECTION

SECTION 233113 – DUCTWORK & DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

B. Furnish and install external insulation on supply, return, exhaust and fresh air ductwork.

1.2 CONTRACTOR COORDINATION

A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

C. Coordinate air distribution devices with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.3 INSULATION QUALITY

A. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.

B. Condensation on any insulated system is not approved.

C. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.

1.4 FINISHES

A. Paint exposed air devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 - PRODUCTS

1.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

1.2 ACCEPTABLE AIR DEVICE MANUFACTURERS

A. Titus.

B. Krueger.

C. Nailor Industries.

D. Price

E. Metalaire

1.3 ACCEPTABLE FABRIC AIR DISPERSION SYSTEM MANUFACTURERS

A. DuctSox Corporation

B. Fabric-Air

C. KE Fibertec

1.4 DUCTWORK STANDARDS AND CODES

A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

1.5 DUCT MATERIAL AND CONSTRUCTION

A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.

B. Rectangular low pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.

C. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.

1.6 DUCT SEALING OF SEAMS AND JOINTS

A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.

1.7 FLEXIBLE DUCT LOW PRESSURE

A. Construction:
   1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
      a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
   2. UL 181 Class I air duct label
   3. Reinforced vapor barrier jacket

4. Rated for use at system pressure (6" wc minimum)
5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.

B. Fire hazard classification:
1. Flame spread rating 25 maximum.
2. Smoke developed rating 50 maximum.

C. Thermal characteristics:
1. R-6 BTU/hr/sq. ft./°F
2. 2" wall thickness insulation with 1" overlap

D. Acceptable manufacturers:
1. Flexmaster
2. Hart & Cooley
3. Omniair

1.8 FABRIC AIR DISPERSION

A. Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:
1. Fabric Construction: 100% Flame Retardant and treated with a machine wash-able anti-microbial agent from the manufacturer.
2. Weight: 6.75 oz./yd^2 per ASTM D3776
3. Fabric Porosity: 1.5 (+2/-1) cfm/ft^2 per ASTM D737, Frazier
4. Temperature Range: 0 degrees F to 180 degrees F
5. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements of NFPA 90-A and ICC AC 167.
6. Antimicrobial agent shall be proven 99% effective after 10 laundry cycles per AATCC Test Method 100.

B. Systems Fabrication Requirements:
1. Air dispersion and extended throws accomplished by reinforced orifices and permeable fabric. Reinforced orifices are to be installed to deep the integrity of opening and withstand laundry processes.
2. Diameter, quantity, and location of reinforced orifices to be specified and approved by manufacturer.
3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
4. Inlet connection includes zipper for easy removal/maintenance.
5. Lengths to include required zippers as specified by manufacturer.
6. System to include adjustable flow devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 – 0.60 in w.g. static pressure.
7. End cap includes zipper for easy maintenance.
8. Fabric system shall include connectors to accommodate suspension system listed below.
9. Any deviation from a straight run shall be made using a gored elbow or an efficiency tee. Normal 90 degree elbows to be 5 gores with the radius of the elbow 1.5 times the diameter.

C. Systems Design Parameters:

1. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.
2. Do not use fabric diffusers in concealed locations.
3. Fabric diffusers shall be designed from 0.25” water gage minimum to 3.0” maximum, with 0.5” as the standard.
4. Fabric air diffusers shall be limited to design temperatures between 0 degrees F and 180 degrees F (-17.8 degrees C and 82 degrees C).
5. Design CFM, static pressure and diffuser length shall be designed or approved by the manufacturer.

D. Fabric Tensioning System:
1. Air diffusers shall be constructed with internal tensioning frame.
2. System shall cylindrically tension textile along the entire length of textile duct.
3. Tensioning system shall include full 360 degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
4. Interior structure to include multiple mechanically adjustable tension devices. To provide proper textile tensioning, structural and textile system shall be configured in segments of no more than 45 feet.
5. Textile components supported solely by metal cylindrical rings.
6. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
7. Component options include:
   a. Stainless Steel Cable
   b. Adjustable Gripple Mid-Supports – incremental lengths of 5’, 10’, 15’, 20’ and 30’

1.9 FIRE DAMPERS

A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance.

B. Acceptable Manufacturers:
1. Ruskin
2. Prefco Products
3. Air Balance
4. Greenheck, Inc.
5. Nailor Industries
6. Pottoroff

1.10 WALL LOUVERS

A. Refer to schedule on drawings. Coordinate with Architectural Drawings.

B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft.; Shall be a minimum of 800 ft/min.

C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.

D. Acceptable manufacturers:

1. Ruskin
2. Arrow
3. American Warming and Ventilation
4. NCA

1.11 DUCT LINING

A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

1.12 CONTROL DAMPERS

A. Opposed blade dampers for 2-position and modulating control. Construct frames of 13-gauge galvanized sheet metal with provisions for duct mounting. Damper blades not exceeding 8" in width, of corrugated type construction, fabricated from two sheets of 22-gauge galvanized sheet metal spot-welded together or a single 16-gauge sheet. Make bearings of nylon or oil impregnated, sinthered bronze. Make shafts of 1/2" zinc plated steel. Blades shall be suitable for high velocity performance. Construct damper so that leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure. Provide replaceable resilient seals along top, bottom and sides of frame and along blade edge. Submit leakage and flow characteristics data with shop drawings. Linkage shall be concealed out of the air stream within damper frame to reduce pressure drop and noise.

B. Acceptable Model is Ruskin Model CD60 or equal by Greenheck.

1.13 VOLUME DAMPERS

A. Manual balancing dampers that meet or exceed the following minimum construction standards:
1. Frame 16-gauge
2. Blades 16-gauge
3. Bearings corrosion resistant
4. Concealed linkage
5. Opposed blade dampers

B. Acceptable manufacturer:
1. Ruskin Model MD-35 or equal, by
2. Greenheck
3. American Warming and Ventilating
4. Nailor Industries
5. Pottoroff

1.14 ACCESS DOORS

A. Round spin-in door of galvanized steel.
1. Fire proof sealing gaskets and quick fastening locking devices
2. Insulated door
3. Conform to the requirements of the NFPA
4. Identification and use of each access door
5. UL label to match the construction in which it is installed
6. Cable attached to door and outer frame
7. Low leakage Access Door

B. Acceptable Manufacturer
   1. Flex master, Inspector Series
   2. Approved Equal

1.15 DIFFUSER FITTINGS LOW PRESSURE TAPS

A. Fitting shall meet or exceed the following minimum construction standards:
   1. Conical with a base diameter two inches larger than the tap diameter.
   2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
      a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
      b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
      c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
   3. Barrel length of at least 9 inches
   4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
   5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.
   6. Provide the damper with a self-locking regulator and handle.
   7. Provide a 2” sheet metal stand-off to extend the regulator.
   8. Flex duct grip area – 2 inches behind retaining bead
   9. Flex duct retaining bead – 1 inch from end
   10. Conical length of at least 3 inches

1.16 AUXILIARY DRAIN PANS

A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2”, all joints soldered watertight. Pan is to be large enough to completely cover drip lines of unit.

1.17 DUCTWORK INSULATION

A. Glass fiber blanket duct insulation. Minimum density of 1.0 pcf, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector. Acceptable Manufacturers: Manville R-series Microlite FSKL, Owens-Corning ED100 RKF, or Knauf 1.0 PCF FSK.

1.18 FLUES FOR ATMOSPHERIC FURNACES AND WATER HEATERS

A. Type B, round or oval, double wall vent pipe, equal to Metalbestos or Metal-Fab, including accessories such as vent caps by the same manufacturers. Use oval vent where necessary to fit in wall construction. All exterior components shall be 304 stainless steel for outdoor installations.

B. Stainless steel flue caps of a design so that wind action from any direction will create a vacuum in the flue. Caps as manufactured by Breidert or equal are acceptable.

PART 3 - EXECUTION

3.1 DUCTWORK INSTALLATION

A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.

B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.

C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.

D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.

E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.

F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.

G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.

H. Fire Dampers shall be installed per manufacturer’s recommendations to create a UL rated assembly.

I. Install end bearing at all location where damper shaft penetrates duct wall.

J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

K. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing on all concealed duct.

L. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2” thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.

M. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2”. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve inch centers to prevent sagging of insulation.

N. On circumferential joint, the 2” flange on the facing shall be stapled with 9/16” outward clinch steel staples on 2” centers and taped using 3” wide foil tape applied with additional adhesive. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.

3.2 DUCTWORK

A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume

air handling units and the terminal units shall be constructed to the medium pressure ductwork specification.

B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.

C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.

D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.

E. Use pushrod operator with locking nut and butt hinges assembly.

F. Provide opposed blade volume dampers with an appropriate control device in each of the following locations:
1. Return air ductwork
2. Outside air branch duct
3. Exhaust branch duct

G. Elbows
1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single wall or airfoil turning vanes. Job fabricated turning vanes, if used, shall be single thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.

H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.

I. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

J. Insulated Flexible Duct
1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal

insulation material.

2. Construct bends over 45° with sheet metal elbows.

K. Duct Supports.

1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.

3.3 PLENUMS

A. Return air plenums shall be duct board.

3.4 FLEXIBLE CONNECTIONS

A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands; where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations:

1. Fire Dampers
2. Outside Air Dampers
3. Duct Mounted Coils (up-stream)
4. Control Dampers

3.6 DUCT LINING

A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.

B. Provide metal nosing that is either channeled or "Z" profiled or are integrally formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.

C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.

3.7 SEALING OF SEAMS AND JOINTS

A. Seal supply, return, exhaust and outside air duct systems.

3.8 SCREENS

A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.9 CONNECTIONS TO LOUVERS

A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.

B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.10 AUXILIARY DRAIN PANS

A. Where coils that have a condensate drain are located above ceiling.

3.11 AIR DEVICE INSTALLATION

A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws. For perforated diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

B. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

3.12 INSTALLATION OF FABRIC AIR DISPERSION SYSTEM

A. Install approved suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product.

B. Clean air handling unit and ductwork prior to installation of the fabric duct system. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.

C. Temporary closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

D. If fabric duct systems become soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

3.13 FLUES

A. Provide and install flues for all gas fired equipment.

B. Refer to plans for all related locations.

C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.

D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.

E. Terminate flues at height above roof to prevent flue gas from entering the building.

END OF SECTION

NORTH TRANSFER CENTER

SECTION 236000 - HVAC EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a split DX air-cooled condensing unit, fan coil unit and controls required for the air conditioning and heating system. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping. Provide and install air conditioning condensate drains.

B. Provide and install a single-package, single-zone, electric air conditioner with gas-fired electric heat for a rooftop ground-mounted application.

C. Furnish and install exhaust/supply fans, including centrifugal, axial and propeller types, with supplemental equipment.

D. Provide and install electric unit heaters complete with heating element, propeller mounting brackets and other options as specified.

1.2 PERFORMANCE

A. Provide air conditioning performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

B. Provide exhaust/supply fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SPLIT DX AIR CONDITIONING UNIT MANUFACTURERS

A. Carrier

B. Trane

C. York/JCI

D. Rheem/Ruud

2.2 ACCEPTABLE PACKAGED DX AIR CONDITIONING UNIT MANUFACTURERS

A. Carrier

B. Trane

C. York/JCI

D. McQuay

E. Reznor

F. Aaon

G. Addison

2.3 ACCEPTABLE EXHAUST/SUPPLY FAN MANUFACTURERS

A. Cook

B. Greenheck

C. Penn Barry Ventilator

D. Acme

2.4 ACCEPTABLE UNIT HEATER MANUFACTURERS

A. Modine.

B. Reznor.

C. Chromalox

D. Trane.

E. Markel

2.5 CONDENSING UNIT

A. Compressor. Provide a hermetic or semi-hermetic compressor with crankcase heaters, inherently protected motors, spring mounts and capacity modulation. Provide each compressor with a 5-year parts and labor warranty.

B. Refrigerant. Provide refrigerant not scheduled for phase out during life of the unit.

C. Condenser Coils. Provide copper tubes with mechanically bonded aluminum fins. Protect condenser coils with a heavy gauge, corrosion resistant wire guard.

D. Fan and Motors. Provide propeller-type fans with direct drive or belt drive and vertical discharge. Protect fan with a heavy-gauge, corrosion resistant wire guard. Provide inherently protected, permanently lubricated, and weatherproof motors.

E. Casing. Furnish a unit designed for outdoor mounting. Fabricate the casing of heavy gauge steel, zinc coated and finished with enamel. Provide removable access panels.

F. Controls. Provide safety and operating controls factory wired and mounted in a separate enclosure. Include thermostatic expansion valve, high and low pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections.

G. Thermostat. Low voltage, 7-day Wi-Fi Compatible programmable thermostat with individual Heating/Cooling setpoints, automatic Heat/Cool change-over, On-Off-Auto fan selection, and Sub-Base Heat-Off-Cool-Auto system selection. Wi-Fi CompatibleHoneywell Wi-Fi Smart Thermostat - RTH9580 or equal.

2.6 FAN COIL UNIT

A. Fan. Provide multi-speed direct connected fan motor with built-in motor protection.

B. Housing. Construct the unit of galvanized steel sheets, and formed members. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.

C. Filter. Provide full length tracks to support the filter. The filter cells shall be Disposal media and frame. MERV 10.

D. Cooling Coils: Constructed of copper tubes and aluminum fins. Designed and circuited for use with direct expansion refrigeration.

E. Electric Heater. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame.

F. Gas Heating Section. Unit shall be equipped with corrosion resistant burners and heat exchangers with Automatic gas valve, pressure regulator, manual shutoff valve, Pilot valve, two flame rollout limit switches, an adjustable fan control and Fixed high limit controls
1. Unit shall be equipped with an electric spark pilot ignition system with electronic flame detection and 100% safety shutoff.
2. Combustion air shall be induced by a positive pressure power venting fan.
3. Prepurge of combustion chamber.

2.7 PACKAGED DX AIR CONDITIONING UNIT

A. Compressor. Provide a hermetic or semi-hermetic compressor with crankcase heaters, inherently protected motors, spring mounts and capacity modulation. Provide minimum number of stages as scheduled on the drawings. Provide each compressor with a 5-year parts and labor warranty. Provide a minimum of three stages of cooling with hot gas reheat.

A. Refrigerant. Provide refrigerant not scheduled for phase out during life of the unit.

B. Condenser and Evaporator Coils. Provide copper tubes with mechanically bonded aluminum fins. Protect condenser coils with a factory installed hail / vandalism guards. Provide fully modulating hot gas bypass for evaporator coil.

C. Condenser Fan and Motors. Provide propeller-type fans with direct drive or belt drive and vertical discharge. Protect fan with a heavy-gauge, corrosion resistant wire guard. Provide inherently protected, permanently lubricated, and weatherproof motors.

D. Casing. Provide a cabinet constructed of galvanized or zinc-coated steel, primed and coated with baked enamel and suitable for outdoor installation. Double wall construction with 1-1/2 lb. insulation and removable access panels.

E. Filters. Provide full length tracks to support the filter. The filter cells shall be Disposal media and frame. 2" thick MERV 10.

F. Dampers. Provide manually operated outdoor air and return air balancing dampers. Provide motorized shut-off damper in outside air opening.

G. Electric Heater. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame. Provide staging as scheduled.

H. Gas Heating Section. Unit shall be equipped with corrosion resistant burners and heat exchangers with Automatic gas valve, pressure regulator, manual shutoff valve, Pilot valve, two flame rollout limit switches, an adjustable fan control and Fixed high limit controls
1. Unit shall be equipped with an electric spark pilot ignition system with electronic flame detection and 100% safety shutoff.
2. Combustion air shall be induced by a positive pressure power venting fan.
3. Prepurge of combustion chamber.

I. Roof Curb. Install a 14" tall minimum roof curb of the same manufacture as the air conditioning unit. Curb to support the unit and provide a watertight enclosure to protect ductwork and utility services. Use a design complying with National Roofing Contractors Association requirements. Level curb according to manufacturer's recommendations.

J. Service Disconnect and Convenience Outlet. Provide a Non-fused disconnect switch with external locking handle and a 120V GFI outlet in unit cabinet.

K. Controls. Provide safety and operating controls factory wired and mounted in a separate enclosure. Include thermostatic expansion valve, high and low pressure switches and compressor motor overload devices. Furnish a time delay device to prevent short cycling. Employ a control transformer, a pressure relief device and suction and discharge valves with service connections.

L. Thermostat. Low voltage, 7-day Wi-Fi Compatible programmable thermostat with individual Heating/Cooling setpoints, automatic Heat/Cool change-over, On-Off-Auto fan selection, and Sub-Base Heat-Off-Cool-Auto system selection. Wi-Fi CompatibleHoneywell Wi-Fi Smart Thermostat - RTH9580 or equal.

M. Temperature Control. Unit shall be controlled by maintaining a constant suction pressure with a leaving air temperature as scheduled on the drawings. When the outside air drops below the scheduled leaving air temperature, a duct mounted temperature sensor shall stage the heating to maintain the set point. Open outside air damper prior to starting fan.

2.8 REFRIGERANT PIPING.

A. Furnish refrigerant piping of Type K hard drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

B. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

C. Provide filter dryer.

2.9 CONDENSATE PIPING

A. Schedule 40 PVC pipe with draining pattern fittings. Type “L” copper with drainage pattern fittings in plenum spaces only.

2.10 ELASTOMERIC INSULATION

A. Insulation material shall be ¾” flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision.

2.11 EXHAUST/SUPPLY FANS

A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.

B. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.

C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.

D. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.

E. Provide duct flanges where required for connections.

F. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.

G. Furnish supply fans with 1” aluminum, washable filter section.

H. Rooftop Fan Components:
1. Aluminum, stainless steel or plastic coated bird guard.
2. Screws and fasteners of stainless steel or nonferrous material.
3. All aluminum construction unless indicated otherwise on fan schedule
4. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine alloy aluminum.
5. Aluminum base shall be continuously welded curb cap corners.

2.12 UNIT HEATER

A. Casing:
1. Construct casing of sheetmetal with a structural frame.
2. Enamel or lacquer finish to manufacturers standard.

B. Gas Heat Exchanger: Direct-fired primary heat exchanger tubes constructed of stainless steel.

C. Electric Heating Elements:
1. Shall bear the UL label.
2. Corrosion resistant materials.
3. Heating coil of 80-20 nickel-chrome wire.

D. Automatic controls:
   1. Factory mounted
   2. Prewired to the junction box
   3. Unit mounted thermostats 24-volt low voltage

E. Safety Controls:
   1. A primary and secondary thermal cut-off to de-energize each circuit.
   2. Manual reset high limit
   3. Automatic reset thermal protection

F. Propeller blade fan
   1. Construct the fan of aluminum or other corrosion-resistant material.
   2. Statically and dynamically balanced
   3. Substantial fan guard

PART 3 – EXECUTION

3.1 CONDENSING UNIT INSTALLATION

A. Mount condensing units on 4" foundation pads and pipe as shown on Drawings or as recommended by the equipment manufacturer. Install refrigerant filter dryer and sight indicating glass.

B. Furnish and install control wiring as required. Install control wiring in conduit.

C. Furnish and install a thermostat with each condensing unit. Control wire shall be installed in a ½" minimum conduit between the wall and the unit.

3.2 FAN COIL UNIT INSTALLATION

A. Install unit so motor connections and filters are accessible.

B. Install unit in secondary sheet metal drain pan with welded edges and overflow float switch. Support unit in pan with 2" tall minimum sheet metal legs. Entire unit with fan coil shall be hung with 3/8" all thread rod and unistrut rails or platform mounted on a 6" raised platform constructed out of acceptable building materials. Coordinate with Architect prior to installation.

C. Route condensate drain from unit to nearest drain point or as shown on the drawings.

D. Provide new set of filters at substantial completion.

3.3 PACKAGED DX AIR CONDITIONING UNIT INSTALLATION

A. Install according to manufacturer's recommendations and as shown on drawings.

B. Unit is to be provided with a through-the-bottom service connection accessory package and must be used for electrical connections to unit. Use bulkhead connectors to make a waterproof connection.

C. Seal all duct connections to roof curb for air tight connection. Install a 90 degree flanged ductwork connection to the roof curb. Provide and install gasketing around duct flanges. Provide and install gasketing around outer edge of roof curb.

D. Mount units on 4" foundation pads and duct out the side of the unit. Provide adapter if ductwork must come out bottom of unit.

E. Route condensate drain from unit to nearest roof drain downspout catch basin or as shown on the drawings.

3.4 REFRIGERANT PIPING

A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

B. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 300 psig.
1. Test joints with a Halide torch or an electronic leak detector.
2. Repair leaks and retest each system until proved tight.

C. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 2 hours).
2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.5 CONDENSATE PIPE

A. Install the system to facilitate easy removal. Use threaded plugged tee at each change of direction to permit cleaning. Install a cleanout every 50 feet of straight run piping. Maintain a positive slope on all piping

B. Install a water seal trap leg based on the fan pressure. Size the length of the trap leg 1 inch larger than the actual system pressure.

C. Do not install piping sized smaller than the unit drain connection size. Minimum pipe size shall be 3/4".

3.6 REFRIGERANT AND CONDENSATE PIPING INSULATION.

A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding un-slit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.

B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Adhesive.

C. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

3.7 EXHAUST/SUPPLY FAN

A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.

B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in

place, bearings lubricated and the fan has been run under observation.

C. Roof mounted fans shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x ¼" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.

D. Install curbs and equipment in level position.

E. Ceiling mounted in-line centrifugal blowers
   1. Shall be suspended from structure with 3/8-inch zinc plated all-thread rods secured to structure.
   2. Provide sub-structure where required.
   3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.8 UNIT HEATER

A. Furnish units with suitable connections for mounting as shown or as otherwise approved.

B. Provide start-up to ensure correct operation of unit.

C. Adjust discharge louvers to control direction of air flow.

END OF SECTION

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. A: Ampere, unit of electrical current.
2. AC or ac: Alternating current.
3. AFCI: Arc-fault circuit interrupter.
4. AIC: Ampere interrupting capacity.
5. AL, Al, or ALUM: Aluminum.
6. AWG: American wire gauge; see ASTM B258.
7. CATV: Community antenna television.
8. CB: Circuit breaker.
9. cd: Candela, the SI fundamental unit of luminous intensity.
10. CU or Cu: Copper.
11. CU-AL or AL-CU: Copper-aluminum.
12. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
13. dBm: Decibel absolute power with respect to 1 mW.
14. DC or dc: Direct current.
15. EGC: Equipment grounding conductor.
16. EMI: Electromagnetic interference.
17. EV: Electric vehicle.
18. EVPE: Electric vehicle power export equipment.
19. EVSE: Electric vehicle supply equipment.
20. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
21. FLC: Full-load current.
22. ft: Foot.
23. GEC: Grounding electrode conductor.
24. GFCI: Ground-fault circuit interrupter.
25. HDPE: High-density polyethylene.
26. HVAC: Heating, ventilating, and air conditioning.
27. Hz: Hertz.
28. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
29. IP: Ingress protection rating (enclosures); Internet protocol (communications).
30. kAIC: Kiloampere interrupting capacity.
31. kcmil or MCM: One thousand circular mils.
32. kV: Kilovolt.

33. kVA: Kilovolt-ampere.
34. kVAr or kVAR: Kilovolt-ampere reactive.
35. kW: Kilowatt.
36. kWh: Kilowatt-hour.
37. LED: Light-emitting diode.
38. lm: Lumen, the SI derived unit of luminous flux.
39. LV: Low voltage.
40. MLO: Main lugs only.
41. MV: Medium voltage.
42. MW: Megawatt.
43. MWh: Megawatt-hour.
44. NC: Normally closed.
45. NO: Normally open.
46. NPT: National (American) standard pipe taper.
47. OCPD: Overcurrent protective device.
48. PVC: Polyvinyl chloride.
49. SPD: Surge protective device.
50. TVSS: Transient voltage surge suppressor.
51. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
52. UL CCN: UL Category Control Number.
53. V: Volt, unit of electromotive force.
54. VA: Volt-ampere, unit of complex electrical power.
55. W: Watt, unit of real electrical power.
56. Wh: Watt-hour, unit of electrical energy usage.
57. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. ERMC: Electrical rigid metal conduit.
3. FNMC: Flexible nonmetallic conduit. See "LFNC."
4. HDPE: HDPE underground conduit (thick wall).
5. HDPE-40: Schedule 40 HDPE underground conduit.
6. HDPE-80: Schedule 80 HDPE underground conduit.
7. IMC: Steel electrical intermediate metal conduit.
8. LFMC: Liquidtight flexible metal conduit.
9. LFNC: Liquidtight flexible nonmetallic conduit.
10. PVC: Rigid PVC conduit.
11. PVC-40: Schedule 40 rigid PVC conduit.
12. PVC-80: Schedule 80 rigid PVC Conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. CATV: Coaxial general-purpose cable.
2. CATVP: Coaxial plenum cable.
3. CATVR: Coaxial riser cable.
4. CM: Communications general-purpose cable.

5. CMG: Communications general-purpose cable.
6. CMP: Communications plenum cable.
7. CMR: Communications riser cable.
8. MV: Medium-voltage cable.
9. OFC: Conductive optical fiber general-purpose cable.
10. OFCG: Conductive optical fiber general-purpose cable.
11. OFCP: Conductive optical fiber plenum cable.
12. OFCR: Conductive optical fiber riser cable.
13. OFN: Nonconductive optical fiber general-purpose cable.
14. OFNG: Nonconductive optical fiber general-purpose cable.
15. OFNP: Nonconductive optical fiber plenum cable.
16. OFNR: Nonconductive optical fiber riser cable.
17. RHH: (high heat) Thermoset rubber, heat-resistant cable.
18. RHW: Thermoset rubber, moisture-resistant cable.
19. THW: Thermoplastic, heat- and moisture-resistant cable.
20. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
21. THHW: Thermoplastic, heat- and moisture-resistant cable.
22. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
23. USE: Underground service-entrance cable.
24. XHH: Cross-linked polyethylene, heat-resistant cable.
25. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Direct Buried: Installed underground without encasement in concrete or other protective material.
8. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to

protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
b. Concrete Box: A box intended for use in poured concrete.
c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
k. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
l. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
m. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
n. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
o. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

9. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
10. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB);

and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

11. Jacket: A continuous nonmetallic outer covering for conductors or cables.
12. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
13. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
14. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
15. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
16. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
17. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
18. Sheath: A continuous metallic covering for conductors or cables.
19. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
20. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
    f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

21. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide manufacturer’s cutsheets, emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device.
2. Include the following information:

a. Manufacturer's operating specifications.
b. User's guides for hardware.
c. Schedule of maintenance material items recommended to be stored at Project site.
d. Detailed instructions covering operation under both normal and abnormal conditions.
e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
f. List of load-current and overload-relay heaters with related motor nameplate data.
g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
h. Manufacturer's instructions for setting field-adjustable components.
i. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.

1.4 QUALIFICATIONS

A. ERMC-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERMC-S-PVC manufacturer prior to starting installation.

B. EVSE Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by EVSE manufacturer prior to starting installation.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.3 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.4 FIELD QUALITY CONTROL

A. Training: With assistance from factory-authorized service representatives, train Owner's maintenance personnel~~ on the following topics:~~

~~1. How to adjust, operate, and maintain equipment specified in Section 111136 "Vehicle Charging Equipment."~~
~~2. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."~~
~~3. How to adjust, operate, and maintain luminaires and photoelectric controls specified in Section 265619 "LED Exterior Lighting."~~

END OF SECTION 260010

SECTION 260500 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.

B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

A. Electrical work shall comply with applicable inspection services:
1. Underwriters Laboratories,
2. National Fire Protection Association,
3. State Health Department,
4. Local Municipal Building Inspection Department adopted codes with amendments,
5. National Electrical Code with local amendments.

B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract.

C. Obtain all permits required & pay all fees for such permits.

1.3 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than three (3) systems of comparable size and type that have served their Owners satisfactorily for no less than three (3) years.

1.4 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.5 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
1. Field conditions.
2. Condition of installation.
3. Quality of workmanship.
4. Start-up of equipment.
5. Testing and adjusting of equipment.

B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect/Engineer.

1.7 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage, unless specifically noted on the drawings; and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.

C. It is the responsibility of the Contractor to review the architectural drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and other consultant equipment drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.

1.8 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.

1.9 SPACE REQUIREMENTS

A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.10 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.

B. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

1.11 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.12 GUARANTEE

A. Guarantee work for one (1) year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.13 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two (2) or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.14 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.15 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted seven (7) days before bid due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to

the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Documents.

1.16 UTILITIES, LOCATIONS AND ELEVATIONS

A. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.17 WARRANTIES

A. Submit three (3) copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.18 BUILDING CONSTRUCTION

A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.19 TEMPORARY FACILITIES

A. General: Refer to Division 1 for general requirements on temporary facilities.

B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.

C. Temporary facilities, wire, lights, and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

1.20 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

A. Content of Manual:
   1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
      a. Contractor, name of responsible principal, address and telephone number
      b. A list of each product required to be included, indexed to content of the volume.
      c. List with each product, name, address and telephone number of:
         1) Subcontractor or installer
         2) Maintenance contractor as appropriate
         3) Identify area of responsibility of each.
         4) Local source of supply for parts and replacement
      d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
   2. Product Data:
      a. Include those sheets pertinent to the specific product.

b. Annotate each sheet to:
   1) Identify specific product or part installed.
   2) Identify data applicable to installation.
   3) Delete references to inapplicable information.

3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems
      2) Control and flow diagrams
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
4. Written text as required to supplement product data for the particular installation.
5. Copy of each warranty, bond and service contract issued
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure
      2) Instances that might affect validity of warranties or bonds
6. Shop drawings and product data as specified.

B. Sections for Equipment and Systems:
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts:
   b. Operating procedures:
      1) Start up, break-in, routine / normal operating instructions
      2) Regulation, control, stopping, shut down and emergency instructions
      3) Summer and winter operating instructions
      4) Special operating instructions
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting
      3) Disassembly, repair and reassembly
      4) Alignment, adjusting and checking
      5) Routine service based on operating hours
   d. Servicing and lubrication schedule
      1) List of lubricants required
   e. Manufacturer's printed operating and maintenance instructions.
   f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
      1) Electrical
      2) Controls
      3) Communications
   g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
      1) Predicted life of part subject to wear
      2) Items recommended to be stocked as spare parts
   h. Schedule of fuses
   i. Complete equipment field accessible internal wiring diagrams
   j. Schedule of lamps
   k. Schedule of ballasts
   l. Each Contractor's coordination drawings
      1) As installed color coded piping diagrams.
   m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage

n. Other data as required under pertinent sections of the specifications

2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 16.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

1.21 SHOP DRAWINGS AND PRODUCT DATA

A. Submittals shall not be combined or bound together with any other material submittal.

B. Submittal Specification Information:
1. Every submittal document shall bear the following information as used in the project manual:
a. The related specification section number
b. The exact specification section title
2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

C. Submit individually bound shop drawings and product data for the following when specified or provided:
1. Electrical cable trays
2. Enclosed Switches and Circuit Breakers
3. Enclosed Motor Controllers
4. Panelboards and enclosures
5. Wiring devices
6. Transformers
7. Busway
8. Switchboards
9. Sports Lighting Equipment, Fixtures, Poles, Ballast and Lamps
10. Lighting fixtures, ballasts and lamps
11. Site Lighting Poles, Fixtures, Ballast and Lamps
12. Architectural Dimming Systems
13. Theatrical Lighting Systems
14. Lightning protection system
15. Emergency/Standby generator sets and transfer switches
16. Motor control centers
17. Electrical controls and time switches
18. Surge Protection Devices
19. Electrical Contactors
20. Lighting Controls and Occupancy Sensors
21. Surface Raceways
22. Medium Voltage Cable and Connectors
23. Fire Rated Cables and Connectors

D. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not

Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavate trenches for underground raceways to the required depth to ensure minimum coverage.

B. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are required by other Divisions, use stabilized sand to six inches above conduits, continue backfill with select fill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in other Divisions.

3.2 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:
1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack and rooftop equipment (ie: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
   a. Utility Power: White letters on black background
   b. Identifying nameplates shall have ½-inch high, engraved letters for equipment designation and ¼-inch letters indicating source circuit designation, (i.e., “PANEL HA –served from MDP-6 located in Mech. Rm. 100”).
   c. Each switchboard, distribution panel, and motor control center branch circuit device shall have a nameplate showing the load and location of load served in ¼-inch high, engraved letters. Circuit breaker name and kirk key if applicable.
   d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e., Panel “HA-Section 2 – served from MDP-6 located in Mech. Rm. 100”)
   e. Enclosed switches, starters, circuit breakers and contactors: Provide neatly typed label inside each motor starter and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating. Provide Phenolic nameplate on cover exterior to indicate motor or load served, location of load served, panel(s) and circuit(s) serving load(s), description and location of control controlling contactor (i.e., contactor controlled by switch in Room A107.),

and panel and circuit feeding line side of control transformer. Example of label for lighting / receptacle contactor: Lighting Contactor
Panel HA 2,4,6
Control circuit – Panel HA 2,4
Location – West parking Lot Pole Lights
Switched – BMCS

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors." Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.

B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (e.g., Underwriters Laboratories), and approval labels are exceptions to this requirement.

C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.

E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch-wide plastic tape, colored red or orange with suitable warning legend describing buried electrical lines; telephone lines and data lines. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of six (6) inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.

3.3 CUTTING AND PATCHING

A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
   1. Provide the training during regular working day.
   2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.

B. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

D. Demonstrate equipment functions (both individually and as part of the total integrated system).

E. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

F. Submit a report within one week after completion of training. List time and date of each demonstration, time devoted to the demonstration, and a list of people present.

G. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

H. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.5 OPENINGS

A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.6 HOUSEKEEPING PADS

A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.

B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.

C. Concrete pads:
1. Six-inch thick minimum indoors; eight-inch thick minimum outdoors, or thicker if indicated on the drawings or in other sections of the specifications.
2. Chamfer strips at edges and corner of forms.
3. Smooth steel trowel finish.
4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.7 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

3.8 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.9 PROTECTION

A. Protect work, equipment, fixtures, and materials per the manufacturer’s requirements. At work completion, work must be clean and in original manufacturer's condition.

B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.10 OVERCURRENT DEVICE COORDINATION STUDY

A. Contractor shall provide a coordination study and fault current analysis report, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer’s recommendations for all adjustable overcurrent devices specified or provided.

B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.

3.11 EQUIPMENT BACKBOARDS

A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
   1. Provide minimum of two 4 ft. by 8 ft. sheets of plywood for each new telephone equipment terminal location.
   2. Provide minimum of two 4 ft. by 4 ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

A. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

B. The project will not be declared substantially complete until the following has taken place.
   1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
   2. The various systems and building emergency lighting system have been commissioned and accepted.
      a. Building Fire Alarm System
      b. Clock System
      c. Television Distribution System
      d. Building Data / Voice Cabling System
      e. Surveillance and Security System
      f. Intercom / Telephone
      g. Building Emergency Lighting System
      h. Sound Reinforcement Systems
      i. Building Lightning protection System
      j. Building Lighting Occupancy Sensor Controls
      k. Surge Protective Device Equipment

3.13 LOAD BALANCING

A. Balance load on all phases in each panel to within 10% of respective phase loads.

END OF SECTION

SECTION 260510 - UTILITY COORDINATION & SERVICE ENTRANCE

PART 1 – GENERAL

1.1 WORK INCLUDED

A. General: Electrical service shall be provided by local utility company. Provide infrastructure, conduit, ductbanks and pathways from public street right-of-way to building for telecommunications and cable service.

B. Power Company Data: Obtain from utility company information and installation standards for electrical, telecommunication, and cableservice installation.

C. Responsibilities: Determine what equipment and labor is provided by utility company and what equipment and labor is required of this Contractor.

PART 2 – PRODUCTS

2.1 GENERAL

A. Service Data: Ensure that utility company service data is accurate and verified.

2.2 PRIMARY SERVICE

A. General: Division 26 shall provide primary service conduit, manholes, and pull boxes as required and as specified for electrical service. Division 26 shall provide grounding rods, grounding conductors, sleeves, conduits, pull boxes and manholes as required by telecommunications and cable service providers.

B. Electric utility company shall provide primary cables, splices, terminations, and primary underground and overhead service conductors. Telecommunications and cable service utility companies shall provide cabling and connections to the Owner’s demarcation point of service.

2.3 SECONDARY SERVICE CABLE TAP BOXES

A. General: Division 26 shall provide secondary service cable tap boxes as approved by the utility company. Where required or specified, enclosure shall be constructed of NEMA 3R construction.

2.4 SECONDARY SERVICE CONDUCTORS

A. General: Division 26 shall provide secondary service entrance conductors and conduit.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Standards: The installation of the service entrance provisions shall comply with the published standards and requirements of the utility company, the utility company’s specific construction requirements for this project, and with requirements of this Division.

B. Correction: Any failure to meet the standards and requirements shall be corrected to the satisfaction of the utility company and Owner without any additional cost to the Owner.

C. Contractor shall provide all construction materials and labor that the utility company determines to be the responsibility of the customer, at no additional cost to the Owner.

D. The materials and labor required by the for a complete installation shall be provided by the contractor and includes, but is not limited to permanent or removable / lockable vehicular barriers, grounding rods, grounding conductors, sleeves, concrete pads, conduits, metering racks and metering enclosures.

E. Primary distribution poles and service entrance ductbank locations shall be staked and surveyed prior to pole installation by the Contractor to verify their proper placement is within the Owner's property and respective utility easements. Contractor shall verify by survey that the pole and service entrance ductbank location and easements do not interfere with existing easements, right-of-ways, or other restricted properties. Conflicts with existing easements and restrictions shall be brought to the attention of the Architect prior to construction.

F. Contractor shall initiate contact with the utility providers and Owner within 14 days of Notice to Proceed to ensure permanent power will be available to the site. Any delays resulting from lack of this coordination shall be the responsibility of the Contractor.

END OF SECTION

SECTION 260519 - CONDUCTORS & CONNECTORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical conductors, wire and connector work as shown, and specified.

B. Types: The types of conductors and connectors required for the project include the following:
1. 600V building conductors
2. 600V building conductor connectors

C. Application: The applications for conductors and connectors required on the project are as follows:
1. Power distribution circuitry
2. Lighting branch circuitry
3. Appliance, receptacle, and equipment branch circuitry
4. Motor branch circuitry
5. Control wiring
6. Line voltage

D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CONNECTORS

A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.

B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

C. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
1. All wiring inside lighting fixtures shall be temperature rated per NEC.

2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

A. Provide color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.

B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.

C. Conductors:
1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
2. No more than six phase conductors shall be installed in a single raceway.
3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
4. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
5. When more than three (3) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
6. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
7. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
8. For 15 and 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
9. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
10. Do not install a pull string in conduits containing conductors.

D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.

E. Splices and Joints:
1. In accordance with UL 486A, C, D, E, and NEC.
2. Aboveground Circuits (No. 10 AWG and smaller):

a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220˚ F, with integral insulation, approved for copper and aluminum conductors.
b. The integral insulator shall have a skirt to completely cover the stripped wires.
c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.

F. Aboveground Circuits (No. 8 AWG and larger):
1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

G. Underground Branch Circuits and Feeders:
1. Submersible connectors in accordance with UL 486D, rated 600 V, 190˚F, with integral insulation.

3.2 TESTING

A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation:

1. Type RHH and Type RHW-2. Comply with UL 44.
2. Type USE-2 and Type SE. Comply with UL 854.
3. Type TC-ER. Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
4. Type THHN and Type THWN-2. Comply with UL 83.
5. Type THW and Type THW-2. Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type UF. Comply with UL 83 and UL 493.
7. Type XHHW-2. Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper
2. Type: One hole with standard barrels.
3. Termination: Compression

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Coordinate with Architectural drawings for conductors and raceway within the building.

B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

B. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance

with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate with Architectural drawings for sleeve seals at entry to building.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.

2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - ELECTRICAL GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Grounding shall conform to the requirements of:
   1. National Electrical Code.
   2. Governing local codes.
   3. All Local Utility Companies

B. Ground effectively and permanently.
   1. Neutral conductor at the main service disconnect and other separately derived systems.
   2. All conduit systems.
   3. All electrical equipment and related current carrying supports or structures.
   4. All metal piping systems.
   5. All building structural metal frames.
   6. All telephone/voice/video/CATV/data utilities

1.2 REFERENCE STANDARDS

A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."

B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."

C. Article 250 of the NEC (NFPA 70) for grounding.

D. NECA – Standard of Installation

E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

F. EIA / TIA 607

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Copperweld

B. Cadweld

C. Burndy

D. O. Z Gedney

2.2 GROUNDING ELECTRODES

A. Driven Rod Electrode: UL Listed, 3/4" x 10'-0" copper clad grounding electrode.

B. Metal Frame of Building.

C. Foundation concrete encased rebar.

2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

A. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.4 WIRE

A. Stranded, copper cable

B. Foundation Electrodes: 4/0 AWG

C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING

A. In the service equipment, provide a separate (dedicated) ground bus.
   1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
   2. Resistance of neutral to ground shall not exceed 10 Ohms.
   3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground loop.
   4. Provide grounding and bonding at the power company's metering equipment.
   5. Provide access and cover for access to the ground grid and removable connections for testing the system.

B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
   1. In rigid PVC conduit.
   2. Provide connection for each rod ground electrode.
      a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
      b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
      c. The minimum distance between driven ground rod electrodes shall be 10'.
   3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
      a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.

C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.

D. Provide all conduit terminating in transformers, panelboards and voice/data outlets with

grounding bushings, where required and ground wire extended to ground bus in equipment.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

A. Continuity of the building equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.

B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.

C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.

D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.

E. Ground lighting fixture bodies to the conduit grounding system.

F. Receptacles shall require a ground wire bonded to the conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.

G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire inside flexible conduit.

H. Ground each panelboard by connecting the grounding conductors to the grounding stud.

I. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral only at one location either inside the transformer enclosure or at each transformer secondary overcurrent protection device. Ground transformer ground stud or the nearest structural steel member, or nearest member of the ground electrode system.

J. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes panelboards, disconnect switches, receptacles, fans, air handing units, pumps and flexible duct connections.

K. Ground each light pole and metal conduit stub-ups at each light pole base.

L. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.

3.5 ELECTRICAL SWITCHGEAR NOT INTENDED NOR UL LISTED AS SERVICE ENTRANCE RATED

A. Remove all factory installed grounding screws, straps or studs identified for neutral to ground bonding.

B. Do not convert neutral bus to ground bus.

3.6 MANHOLE AND/OR PULL BOX GROUNDING

A. Provide a driven ground rod and ground bond loop in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground loop.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:

1. Rod electrodes.
2. Grounding arrangements and connections for separately derived systems.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:

1) Rod electrodes.
2) Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THWN-2, copper or tinned-copper wire or cable, green color, in accordance with Section 260519 "Low- Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp

1. General Characteristics:

a. Two pieces with stainless steel bolts.
b. Clamp Material: Brass
c. Listed for outdoor use.

E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp

1. General Characteristics:

a. Clamp Material: Brass.
b. Listed for outdoor use.

F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp

1. General Characteristics:

a. Clamp Material: Copper.
b. Listed for outdoor use.

G. UL KDER - Exothermically Welded Connection

1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing

1. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing

1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub:

1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector

1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal

1. General Characteristics: Mechanical-type,copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal

1. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:

1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector
1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

a. Copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector
1. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.

a. Copper

I. UL KDER - Signal Reference Grid Grounding and Bonding Connector:
1. General Characteristics: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

2.6 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.7 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended

location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode >:

1. General Characteristics: Copper-clad; 3/4 inch by 10 ft.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

G. Underground Grounding Conductors: Install bare tinned-copper conductor, 2/0 AWG minimum.

1. Bury at least 30 inch below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

3.3 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.4 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Conductors:

   a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

   a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   b. Make connections with clean, bare metal at points of contact.
   c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
   d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
   f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

      1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
      2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
      3) Use exothermic-welded connectors for outdoor locations; if disconnect-type

connection is required, use bolted clamp.

3. Electrodes:

   a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

      1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
      2) Use exothermic welds for below-grade connections.

4. Equipment Grounding:

   a. Install insulated equipment grounding conductors with feeders and branch circuits.
   b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

      1) Feeders and branch circuits.
      2) Lighting circuits.

   c. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 SUBMITTALS

A. Product Data: For raceways, fittings, handholes and boxes for exterior use, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Grounding details.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Southwire
3. Allied Tube & Conduit
4. Anamet Electrical, Inc.
5. Electri-Flex Co.
6. ColeFlex-ManhattanCDT
7. Maverick Tube Corporation.
8. O-Z Gedney
9. Wheatland Tube Company.
10. Western Tube and Conduit Corporation

C. RMC: Comply with ANSI C80.1.

D. Fittings for Conduit: Comply with NEMA FB 1; listed for type and size raceway with which used.

E. Joint Compound for RMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND FITTINGS

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Endot Industries Inc.
2. Dura-line
3. CANTEX Inc.
4. CertainTeed Corp.
5. Electri-Flex Co.
6. IPEX Inc.
7. Carlon Electrical Products.
8. ColeFlex-ManhattanCDT
9. RACO; a Hubbell Company.
10. Blue Diamond Industries.

C. PVC: Comply with NEMA TC 2.

D. Fittings for PVC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Gray.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.
e. Strongwell.
f. Hubbell

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of raceways, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

3.2 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: RMC.

2. Concealed Conduit, Aboveground: RMC.
3. Underground Conduit, Direct Buried: PVC-40.
4. Underground Conduit, Directional Bored: HDPE-40.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Application of Handholes and Boxes for Underground Wiring: As indicated on Drawings.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. RMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.

D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

E. Do not install aluminum conduits in contact with concrete.

3.3 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

F. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

H. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

I. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

J. Set metal floor boxes level and flush with finished floor surface.

K. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Install underground warning tape as specified in 260553 “Identification for Electrical Systems.”

B. Pushed Conduit:

1. Pushed conduit shall be any conduit installation by means of auguring, drilling, or pushing shall be classified as pushed conduit.

2. Pushed conduit shall be installed at a minimum depth of 30 inches below the existing surface. The Contractor shall not be allowed to cut the existing surface without permission from the Engineer. Permission to cut the existing surface will not be considered unless the Contractor has made a minimum of three workmanlike attempts at each crossing and has been unable to successfully install the conduit by pushing.

3. The diameter of the auger or drill bit shall not exceed the diameter of the conduit by more than 2 inches.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 260533 - CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete system of electrical conduits and fittings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Raceways and Fittings unless otherwise indicated:
1. Allied
2. International Metal Hose
3. Ipex
4. Heritage Plastics
5. Wheatland
6. Can-Tex
7. North American Pipe
8. Anamet, Inc.
9. Electri-Flex Co.
10. Western Tube and Conduit

B. Stainless Steel Conduit and Fittings:
1. Calbrite
2. Gibson

C. Aluminum Conduit and Fittings:
1. American Conduit/Sapa
2. Wheatland
3. Patriot Aluminum Products

D. Condulets and Conduit Bodies unless otherwise indicated:
1. Appleton
2. Form 85

E. Stainless Steel Condulets and Conduit Bodies:
1. Calbrite
2. Gibson
3. Crouse Hinds

F. MC Cable
1. AFC
2. Southwire
3. General Cable
4. Kaf-Tech

2.2 PROHIBITED PRODUCTS

A. Prohibited Products

1. BX cable
2. AC cable
3. Electrical nonmetallic tubing (ENT)
4. Flexible polyethylene or PVC tubing
5. Intermediate Metal Conduit (IMC)

2.3 RIGID METAL CONDUIT (RMC)

A. Schedule 40 conduit and fittings:
   1. Galvanized Conduit - Mild steel pipe, Zinc coated inside and out
   2. Aluminum Conduit - Aluminum Alloy 6063, T-1 temper
   3. Threaded ends and fittings
   4. Insulated bushings

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Metallic Tubing
   1. Zinc Coated Steel - Cold rolled steel tubing, Zinc coated inside and out
   2. Aluminum - Aluminum Alloy 6005, 6063. Temper T-1

B. Fittings shall meet the same requirements as EMT conduits.
   1. Full Compression Fittings
   2. Insulated throat connectors

C. Prohibited Products
   1. Cast metal fittings
   2. Uni-couple type connectors
   3. Split ring, anti-short bushings

2.5 FLEXIBLE CONDUIT

A. Steel flexible metallic conduit:
   1. Zinc coated inside and out
   2. 18-inches minimum length, 24-inches maximum length
   3. 18 inches minimum length; 6 feet maximum length for light fixture whips only

B. Liquid tight flexible steel conduit
   1. Type L.A. - Grounded
   2. 18-inches minimum length, 24-inches maximum length

2.6 PVC CONDUIT

A. Schedule 40 and Schedule 80

B. PVC fittings and solvent welded joints

C. PVC elbows and fittings, except for threaded/slip-on/glue or straight conduit slip-on / glue fittings, shall not be used on this project.

2.7 CONDULETS AND CONDUIT BODIES

A. Form 85

B. PVC Coated: Form 8

C. LBC Condulets shall be used for size 2 inch and above. LL and LR Condulets shall not be used for 2 inch and above

2.8 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

A. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.

B. Acceptable Manufacturer:
1. Portable Pipe Hangers
2. Cooper B-Line C-Port
3. Miro Industries Models 2.5, 2.5-5, 2.5-AH, 12-AH, 16-AH

2.9 STAINLESS STEEL CONDUIT

A. Rigid Conduit, Fittings and Supports:
1. Type 304 Stainless Steel
2. Threaded ends
3. Insulated Bushings

B. EMT, fittings and Supports:
1. Type 304 Stainless Steel
2. Compression Fittings
3. Insulated Bushings

2.10 METAL CLAD (MC) CABLE

A. Minimum conductor size shall be #12 AWG. All conductors shall be copper.

B. All MC Cable shall have an insulated ground conductor.

C. Armor: An aluminum or zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with Section 13 of UL 1569.

D. Fittings shall be UL listed and identified as MCI-A for such use with metal clad interlocking armor ground. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC or MCI-A Cable to box.

2.11 EXTERIOR IN-GRADE PULL BOXES

A. Hubbell CDR 30x48 inch minimum, provide larger size as required by conduit size or quantity:
1. Tier 22 rated traffic duty
2. Conduit entry knock-outs as required
3. Bolt down cover
4. Integral or separate bottom
5. Adjust to grade option
6. Extension as required for specified conduit depth

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical conduits and fittings for all wiring of any type unless otherwise indicated.

B. Minimum Size Conduit:
   1. 0.5-inch unless otherwise indicated
   2. (2) 1-inch for low voltage systems unless otherwise indicated
   3. 2-inch between buildings unless otherwise indicated

C. Provide separate raceway systems for each of the following when specified, indicated or required:
   1. 120/208 volt circuits
   2. 277/480 volt circuits
   3. Emergency
   4. Life safety branch
   5. Critical branch
   6. Equipment branch
   7. Voice/Data
   8. Sound reinforcement
   9. Theatrical and Architectural Dimming Controls
   10. MATV/CATV
   11. Security CCTV
   12. Security System
   13. Communications / PA Systems / Sound System Line Input and Speakers
   14. Fire Alarm
   15. Lighting and Building Management Control Systems

D. Maintain 13-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

E. Cut conduit square using saw or pipe cutter; de-burr cut ends.

F. Use conduit hubs to fasten conduit to sides and tops of electrical equipment, device, box, gutter, wireway, disconnect, etc. in damp and wet locations.

G. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

H. Do not use no-thread couplings and connectors for galvanized steel or aluminum rigid conduit.

I. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.

J. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
   1. Insulated throat connectors for EMT conduits.
   2. Insulated bushing on all rigid conduit terminations.
   3. Locknuts inside and outside of all boxes and enclosures.
   4. Threaded type plastic bushing at all boxes and enclosures.

K. All boxes are to be accessible after completion of construction.

L. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.

M. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.

N. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.

O. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting.

P. Make up threaded joints of conduit carefully in a manner to ensure a tight joint.

Q. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing.

R. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas.

S. Install one 2-inch diameter conduit nipple between multi-sectional panels independent of feeder conductors.

T. Prohibited Installations unless noted otherwise

U. Do not route on floors, paved areas or grade.

V. Do not Obstruct Equipment Manufacturer's Recommended Service Space or access to that location

W. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

3.2 INTERIOR ABOVE GRADE INSTALLATION

A. Conduit Types
   1. Concealed Conduits:
      a. EMT
   2. Exposed conduits in Equipment Rooms:
      a. EMT
      b. RGC when installed below 18-inches above finished floor.
   3. Exposed conduits:
      a. RGC:
         i. Below 9-feet AFF
      b. Aluminum rigid conduit
   4. Wet Location
      a. Aluminum rigid conduit
   5. Damp Location
      a. Aluminum rigid conduit
   6. Conduit in concrete walls, floor or roof slab:
      a. RGC

B. Maintain head room and present neat appearance.

C. Minimum 6-inches clear of bottom of roof deck.

D. Perpendicular or parallel to building lines.

E. Where a piece of equipment is connected from a switch or box on adjacent wall, the conduit shall go up the wall from the box, across, and back down to the equipment.

F. Conceal conduit systems in finished areas.

G. Conduit may be exposed in exposed mechanical and electrical rooms or where otherwise indicated.

H. Prohibited Installations

1. Do not block walkways

3.3 LIGHT FIXTURE WHIPS

A. Flexible conduit or MC cable used for lighting fixture connection shall be supported from the structure with #13 AWG galvanized iron wire pendants and "Caddy clips".

B. Each light fixture shall have its own fixture whip from junction box.

C. Light Fixtures installed end to end or recessed in non-accessible ceilings may connected use chase nipples.

D. Prohibited installation:

1. Do not install “Daisy Chain” light fixtures installed above accessible ceilings.

3.4 BELOW GRADE INSTALLATION

A. Conduit Type:

1. PVC

B. Unless shown otherwise, do not install conduit in or below concrete building slabs.

C. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.

D. Changes in direction of underground conduit runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet and a maximum arc of 22.5 degrees.

E. Provide conduit spacers for parallel branch/feeder conduits. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during concrete placement.

F. Conduit below building slab shall be installed minimum 18-inches below finished floor and in select fill.

G. Electrical feeder conduits, telecommunications tie, trunk, or service cable conduits shall be installed minimum 48-inches below finished floor and in select fill.

H. Electrical service primary shall comply with the respective utility company requirements and standards.

I. Provide two “caution” plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement.

J. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill.

K. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-

inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.

L. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways.

M. Conduit for 120V and above shall be separated from control and signal conduits by a minimum of 3-inches.

N. Prohibited Installation.
1. Unless shown otherwise, do not install conduit horizontally in concrete slabs.

3.5 EXTERIOR ABOVE GRADE INSTALLATION

A. Conduit Type:
1. Aluminum Rigid Conduit
2. RGC where subject to physical damage or where located less than four feet above finished floor, grade or pavement.

B. Conduit for mechanical / plumbing equipment shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.

3.6 ABOVE ROOF INSTALLATION AND ROOF PENETRATION

A. Where specifically indicated to be routed or mounted on the roof, installation shall be as specified, recommended by roofing manufacturer, recommended by roof support manufacturer and as required by NEC.

B. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing.

C. Conduit for equipment mounted on roof curbs shall be routed through the roof curb.

D. Prohibited Installations:
1. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise.
2. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.

3.9 CONDUIT SUPPORTS

A. Fasten conduit supports to building structure and surfaces;

B. Support with malleable iron conduit clamps or on conduit racks at intervals as required by NEC

C. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Channel supports shall have cut ends filed smooth

D. Where rod pendants are not used, channel supports are to be secured to structure at each end.

E. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt “wings” are not acceptable.

F. Support single conduit runs using a properly sized galvanized conduit hanger.

G. Group related conduit on conduit rack. Construct rack using steel channel; provide space on each rack for 25 percent additional conduits.

H. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.

I. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks. Coordinate routing with Architect / Owner.

J. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners.

K. Galvanized Surfaces: Clean welds, bolted connections, cuts, and abraded areas and apply ZRC galvanized paint or equivalent.

L. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with “Tee” conduit at motor outlet height for flexible conduit.

M. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers.

N. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.

O. Anchors:

1. Rawl Plugs or approved equal anchors.
2. Lead cinch anchors or pressed anchors.

P. Hardware:

1. Indoors: cadmium plated unless noted otherwise
2. Exterior: Galvanized unless noted otherwise

Q. Prohibited Installation.

1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
2. Do not support conduit from conduit, ceiling support wires, roof deck, structural bridging
3. Plastic anchors and lead anchors shall not be used for overhead applications.
4. Beam clamp attachments to steel joist chords
5. Do not support more than one conduit from a single all-thread rod support.
6. Do not utilize Tie wire or short pieces of conduit as supports or hangers.

R. Acceptable Manufacturer’s

1. Kindorf,
2. Unistrut,
3. Superstrut,
4. Caddy,
5. Minerallac

3.10 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, grade level other than floor, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
   1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
   2. Sleeves shall extend 3-inches above the finished floor.

B. Sleeves in concrete or masonry walls shall be Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.

C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.

D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to serve as a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.

E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.

F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.11 PVC CONDUIT AND FITTINGS INSTALLATION

A. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.

3.12 FLEXIBLE METAL AND LIQUID TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS INSTALLATION

A. Liquid Tight Flexible Metal Conduit shall only be used for connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.

B. Liquid tight flexible metal conduit may be 0.5-inch for roof top supply / exhaust fans only

C. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc.

D. Prohibited Installation:

1. Do not use for exterior wall or roof penetrations unless sleeved utilizing PVC coated RGC conduit at least one size larger than the outside diameter of the flexible conduit.

3.13 EXTERIOR IN-GRADE PULL BOXES

A. Provide pull boxes where specified and as required.

B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.

C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.14 IDENTIFICATION

A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / communication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 260537 - ELECTRICAL BOXES & FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Label: Electrical boxes and fittings shall be UL labeled.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
   1. Type of Various Locations:
      a. Wall mounted video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613 or equal, 4-gang steel box with white trim plate.
      b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes.
      c. Security, access control , and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
      d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
   2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.

C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.

D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
   1. Type for Various Locations:

a. Minimum Size: 4-inch square, 2-1/8-inches deep.
b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
c. Exterior or Wet Areas: 304 stainless steel NEMA 3R construction with gaskets and corrosion-resistant fasteners

E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.

F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.

G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

2.2 FURNITURE FEED POKE-THROUGH DEVICES

A. Wiremold 4FFATCAL

B. Shall be UL classified for use in up to four hour rated concrete floors, and up to three hour rated steel and concrete floors.

C. Shall be UL listed for use with power and low voltage in a single service fitting and shall protect against ingress of water or foreign material with a neoprene gasket at base of fitting.

D. Shall be installed in a single core drilled hole

2.3 FLOOR BOXES - CONCEALED SERVICE

A. Construction shall be as required by UL 514A.

B. Carpet frame shall be nylon UL Recognized Component QMFZ2.

C. Hinged outer cover shall be reinforced with a 5/32" steel plate.

D. Shall deliver electric power from duplex receptacles installed below the surface of the floor.

E. Shall deliver telephone or data cable without interference from the electric power delivery

F. Shall protect delivery of both services by a hinged cover with a retractable opening and foam plastic dust seal

G. When hinged cover is closed and no services in place, device shall have no obstructions above surface of floor.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.

B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.

C. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes.

D. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.

E. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.

F. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.

G. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.

H. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.

I. Provide knockout closures to cap unused knockout holes in boxes.

J. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.

K. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.

L. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.

M. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.

N. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.

O. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes to correspond to the following colors:
1. Orange: - 480/277 VAC systems
2. Blue: - 240 VAC three phase delta systems.
3. Red – All Emergency circuits, regardless of load, and fire alarm system.
4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
5. Yellow – Building Management and Control System - BMCS
6. White - Security and Surveillance equipment circuits

P. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers.

Q. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

R. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.

S. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

T. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.

U. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.

V. Use stamped steel bridges to fasten flush mounting outlet box between studs.

W. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.

X. Use gang box with plaster ring for single device outlets.

Y. Support outlets flush with suspended ceilings to the building structure.

3.2 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

C. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box.

3.3 FLOOR BOX / POKE THROUGH INSTALLATION

A. Position floor boxes and conduit runs prior to concrete pour per dimensioned drawings from Architect/Engineer.

B. After concrete pour, pull wires and install devices according to manufacturer's recommendations.

C. Activate in accordance with the National Electrical Code.

D. Coordinate with floor covering contractor to complete installation.

E. Core drill openings for poke-through service fitting and install in accordance with manufacturer's instructions.
   1. Minimum spacing of 2' on center and not more than one unit per each 65 square feet of floor area in each span; required by Fire Resistance Directory.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with IEEE C2.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.

4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F**,** material surfaces

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:

1. Black letters on orange field**.**

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded branch-circuit conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240 V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Raceways and Cables Carrying Circuits at More Than 1000 V:

1. Black letters on orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

E. Warning labels and signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

F. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, polyester flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:

a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:

a. 1-1/2 by 6 inch for raceway and conductors.
b. 3-1/2 by 5 inch for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil

thick by 1 to 2 inch wide; compounded for outdoor use.

C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.

D. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inch.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4 inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inch.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

    a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
    b. For signs larger than 20 sq. inch, 1/8 inch thick.
    c. Engraved legend with black letters on white face.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

    1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely

encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

K. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

L. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

M. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

N. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

P. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

Q. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

S. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

T. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

U. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

D. Locations of Underground Lines: Underground-line warning tape for power, lighting,

communication, and control wiring and optical-fiber cable.

E. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

F. Arc Flash Warning Labeling: Self-adhesive labels.

END OF SECTION 260553

SECTION 260923 - LIGHTING OCCUPANCY SENSORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide occupancy sensing control devices so that lighting is turned off automatically in individual rooms or sections of rooms after a reasonable time delay when the last person leaves the room or area.

B. Occupancy sensing controls shall accommodate for irregular use of rooms or areas, all individual work habits, and all occupancy habits or conditions of space utilization. Occupancy sensors must provide full volumetric coverage.

1.2 QUALITY ASSURANCE

A. Product manufacturer shall have a minimum of (5) years experience in the manufacturing of occupancy sensors.

B. All components shall be UL listed, meet all state and local applicable code requirements.

C. All components shall offer a five (5) year manufacturer’s warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Sensor Switch

B. Greengate

C. Watt Stopper

D. My-Tech

E. Hubbell

F. Leviton

G. Schneider Electric

H. Cooper

2.2 FEATURES AND PERFORMANCE PARAMETERS

A. Line voltage wall switch sensor shall include zero crossing switching circuit. Sensor shall operate at 30-34 kHz.

B. Line voltage wall switch sensors shall be ultrasonic and passive infrared and provide no-gap minor motion coverage of an area up to 300 square feet.

C. Line voltage wall switch sensors shall operate on either 120V or 277V and control loads up to 800 watts at 120V and 1200 watts at 277V.

D. Line voltage wall switch sensors shall be compatible with magnetic and electronic ballasts, shall be equipped with high capacity relay contacts with ratings that include tungsten loads.

E. Wall switch sensors shall mount flush into a designer-style wall plate.

F. Dual Technology sensors shall provide no-gap minor motion coverage throughout the entire controlled area. Ultrasonic sensor shall operate at 30-34 kHz.

G. All sensors shall have a manual override switch to allow the load to be turned on without the use of tools or pins in the event of sensor malfunction.

H. Dual Technology Sensors shall have easily accessible, adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.

I. All sensors shall be provided with an indicator light to verify that motion is being detected and that the unit is in operation.

J. Dual Technology sensors shall self-adjust sensitivity to optimize performance.

2.3 SWITCHPACKS

A. For ease of mounting, installation and future service, Switchpacks shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and shall be an integrated, self contained unit consisting internally of a load switching relay and transformer to provide low voltage power. Switchpacks shall power up to five (5) sensors.

B. Relay contacts shall be isolated and have ratings of:

Heavy Duty:

15 Amps:	120 VAC Tungsten
20 Amps:	120/277 VAC Ballast
1HP:	120 VAC
2HP:	250 VAC

BAS
Isolated (Dry) 5 Amp Form C Contacts

C. Control wiring between sensors and Switchpacks shall be Class 2, 18 AWG stranded UL classified, Teflon Jacketed cable suitable for use in plenum ceilings.

D. Enclosures for Switchpacks shall be NEMA I Construction with mounting plates and barriers to provide separation between line and low voltage wiring or standard 4" deep junction box with Switchpack mounting through a 1/2" knockout.

E. The Heavy Duty Switchpack shall have a heavy duty Form A relay and zero crossing circuitry that forces the relay contacts to engage and disengage at the zero crossing point

of the AC voltage source, minimizing the magnitude of the inrush current and increasing the life of the Switchpack.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide the quantity of occupancy sensors required for complete and proper volumetric coverage to completely cover the controlled areas. Contractor shall verify room coverage and ceiling heights with manufacturer and provide the quantity of occupancy sensors as required. Rooms shall have one hundred (100) percent volumetric coverage of small motion detection to completely cover the controlled areas to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms that are to be provided with sensors. Proper judgment must be exercised in executing the work so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural or architectural components. Provide sensors to provide complete and proper volumetric coverage.

B. Exact locations of Switchpack boxes shall be based on observing good installation practice and shall be consistent throughout the project. Switchpacks shall be located in accessible ceiling spaces. Attention shall be paid to all aspects of installation to ensure that there is the minimum aesthetic impact of the hardware on the appearance of the affected rooms. All control unit hardware shall be completely contained within a suitable NEMA-type enclosure, with no exposed wire other than low voltage Class 2 wiring.

C. Control units used for the security or fire systems shall be powered from the emergency power source as indicated on the drawings. Other control units shall be powered from the lighting circuit, which they control.

3.2 INSTALLATION

A. All occupancy sensors and switchpacks shall be of the same manufacturer throughout unless otherwise noted.

B. Install occupancy sensors in areas shown, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

C. Install occupancy sensors and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.

D. Install occupancy sensors plumb and aligned in the plane of the ceiling where they are installed.

E. Refer to Architectural drawing, elevations, etc. for exact location of wall switches where indicated on the Architectural plans. Coordinate location of all wall switches with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.

F. Unless indicated otherwise, circuit switchpacks ahead of local control switches - source → switchpack → local toggle switch(s) → load.

G. Low voltage cabling installed from switchpack to sensor(s) and from sensor to sensor shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six-inches below deck. Suport system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices.

3.3 SENSOR TESTING AND ADJUSTMENT

A. At the time of installation the contractor shall test and adjust each sensor for proper detection of motion appropriate to room usage. The contractor shall follow the testing and adjustment procedures as written in the manufacturer's installation instructions for each sensor model.

B. Prior to testing and adjusting, verify with Owner/Architect the initial settings for each type of area based on its intended function and use.

C. Verify with Owner all adjustable functions of each type of occupancy sensor prior to installation. Set all adjustable functions of each type of occupancy sensor as directed by Owner. Initial settings unless directed otherwise by Owner / Architect:

D. Ceiling Sensors:
1. Auto-On = On
2. Lighting Sweep = Off
3. Self-Adjust = On
4. Energy Saver = Off or Normal
5. Normal Sensitivity
6. Manual Override = Off
7. Maintain Lights On = Either Mode
8. Frequency = 32 kHz

E. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check devices to demonstrate proper operation.

F. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION

SECTION 26 12 15 - DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Low Voltage (less than 600 Volt) transformer work as shown, scheduled, indicated, and specified.

B. Types: Transformers required for the project include dry-type transformers.

1.2 QUALITY ASSURANCE

A. Standards: Transformers shall be designed and tested in accordance with NEMA and ANSI C33.4 and C89.2 standards.

B. UL Label: Transformers shall be UL labeled.

1.3 STANDARDS

A. UL-506

B. ANSI C75.11

C. NEMA ST-20

D. DOE 2016 Efficiencies

1.4 SUBMITTALS

A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, sound level, tap configurations, insulation system type and rated temperature rise.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D

B. General Electric

C. Siemens

D. Eaton

E. Acme

F. Hammond

2.2 MATERIALS AND COMPONENTS

A. Except as otherwise indicated, provide transformer manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended, and as required for a complete installation.

2.3 DRY-TYPE TRANSFORMERS

A. General: Indoor transformers shall be dry-type, multiple-winding transformers, rated as shown, and shall have manufacturer's standard impedance.

B. Construction: Transformer core shall be constructed of cold-rolled, oriented, high permeability silicon steel, either formed as a coil or laminated.

C. Taps: Transformers 15 to 30 kva shall have two 5% taps, one above and one below normal. Transformers 45 kva and larger shall have four 2-1/2% taps, two above and two below normal.

D. Temperature Rating: Transformers shall use an insulation system that has been temperature classified and approved by UL. Transformers shall have a maximum winding temperature rise of 150°C with an insulation system temperature classification of 220°C.

E. Load Rating:
1. Transformers shall be capable of operating at 100% of nameplate rating continuously while in an ambient temperature not exceeding 40°C.
2. Transformers shall be capable of meeting the daily overload requirement of ANSI C57.12.

F. Vibration Isolation: Each transformer core and coil shall be mounted in the transformer enclosure on rubber vibration isolators.

G. Sound Rating: The transformer shall have sound levels equal to or lower than those ratings established in NEMA ST-20 and as shown in the following table. Sound ratings shall be measured in accordance with ANSI C89.91.

Transformer Rating (kva) (600 Volt Class)	Maximum Sound Level Decibels: NEMA ST-20
0 to 9	40
10 to 50	45
51 to 150	50
151 to 300	55
301 to 500	60

H. Testing:
1. The manufacturer shall have tested each transformer for proper operation before shipment.
2. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied. Furnish proof of performance of these tests in the form of test data sheets upon request:
   a. Sound levels.
   b. Temperature rise tests.
   c. Full-load core and winding losses.
   d. Percent regulation with 80 and 100% power factor load.

e. Percent impedance.
f. Exciting current.
g. Insulation resistance.

PART 3 - EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

A. General: Install transformers where shown, in accordance with the manufacturer's written instructions and industry practices to ensure that the transformers meet the specifications. Comply with requirements of NEMA and NEC standards, and applicable portions of NECA Standard of Installation, for installation of transformers. Transformers shall be floor mounted. Ceiling mounted transformers are not acceptable.

B. Dry-Type Transformer Mounting: Indoor, floor mount transformer on properly sized Amber/Booth Type RVD rubber-in-shear vibration isolators. Only where specifically indicated on the plans or approved in writing by the Owner/Engineer, transformers shall be trapeze mounted using properly sized Amber/Booth type BRD rubber-in-shear hangers. Transformer enclosures shall make no contact with wall surfaces.

C. Conduit: Conduit directly connected to transformer enclosures shall be flexible liquid tight conduit extending for a minimum of 18-inches and a maximum of 24 inches from transformer enclosure as measured along the conduit centerline. Include a ground wire, size in accordance with NEC, internal in each length of flexible conduit.

D. Grounding: Ground and bond transformers as a separately derived system unless noted otherwise, refer to NEC 250. Installation of bonding strap or bonding conductor between ground and neutral bus shall be witnessed by the Engineer prior to applying power and terminating secondary conductors.

3.2 TESTING

A. Insulation Tests: Before energizing, check transformer windings for continuity.

B. Winding Current: During initial no-load energizing, check current in each primary winding.

C. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.

D. Submittals: Furnish instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Reports include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.

E. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

SECTION 262400 - ELECTRICAL GEAR

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified. Safety and disconnect switch work where required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Standards: All electrical gear shall confirm to all applicable UL standards and shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric Co.

B. Square D

C. Siemens

D. Eaton

2.2 PANELBOARDS

A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and scheduled.

B. Busing Assembly: Panelboard phase, neutral and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or busbar not to exceed 65°C rise above 40°C ambient. Heat rise test shall be conducted in accordance with UL 67. The use of conductor dimensions is not accepted in lieu of actual heat tests. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Panelboards serving non-linear loads and fed with neutrals greater than 100% shall have 200% neutral busing.

C. Circuit Breakers: Circuit breakers shall be molded case, thermal magnetic type equipped with individually insulated, braced, and protected connectors. The front faces of circuit breakers shall be flush with each other. Tripped indication shall be shown by the breaker handle taking a position between ON and OFF. Make prepared space provisions for additional breakers so that no additional connectors will be required to add breakers. Circuit breakers in panelboards 600 Amps and below shall have bolt-in breakers. Two and three pole breakers shall have internal common trips. External handle ties will not be accepted for line to line connected loads. External handle ties are acceptable only for designated shared neutral loads. Circuit breakers for panelboards rated 601 amps and above shall have plug-on circuit breakers.

1. Provide panelboard branch circuit breakers with interrupting capacity as shown, but in

no case less than the following symmetrical amperes RMS:

Voltage (volts)	Interrupting Capacity
120/208/240	10,000 AIC

2. Circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
3. Ground fault interrupter (GFI) circuit breakers, where shown, shall be 5 mA ground fault trip and shall include a TEST button.
4. Arc fault circuit breakers shall comply with UL 1699.
5. Circuit breakers with frame size 600A and higher shall have magnetic trip adjustment of 3X to 10X.
6. Provide distribution panel circuit breakers with high interrupting capacity, or integral current limiters as shown. Circuit breakers shall have interrupting capacity not less than the following symmetrical amperes RMS:

CONVENTIONAL FRAME SIZE/ VOLTAGE	INTEGRAL INTERRUPTING CAPACITY
100A/240V	10,000 AIC
225A/240V	25,000 AIC
400A/240V	65,000 AIC
600A/240V	65,000 AIC
800A/240V	65,000 AIC

D. Fusible Switches: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class R or Class J fuses and be UL labeled for 200,000 AIC.

E. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.

F. Integrated Equipment Rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed. Series rated panelboards and their protective upstream devices shall be labeled as required by the NEC.

G. Panelboard Enclosures:
1. Provide sheet steel enclosures. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key.
2. All NEMA 1 enclosure panelboards shall be hinged “door-in-door” type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right.
3. Equip with interior circuit directory frame, card, and clear plastic covering for

panelboards.

4. Provide gray powder coat finish over a rust inhibitor.
5. Enclosures at exterior locations shall be NEMA 3R.
6. Enclosure shall be for recessed or surface mounting as shown.
7. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

2.3 ENCLOSED SWITCHES

A. General: Provide commercial duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be horsepower rated for the motor served.

B. Switch Mechanism:
1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.
2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.

C. Fusing: Provide fusible safety switches where required or indicated. Fuse clips shall be positive pressure rejection type fuse clips suitable for use with UL Class R or Class J fuses.

D. Neutral: Provide safety switches with number of switched poles indicated. Where a neutral is present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.

E. Enclosures in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise. Enclosures in exterior locations shall be NEMA 3R stainless steel, heavy duty

2.4 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
   a. Instantaneous trip
   b. Long-and short-time pickup levels.
   c. Long-and Short-time time adjustments.
   d. Ground-fault pickup level, time delay and I^2t response

B. Molded-Case Circuit Breaker Features and Accessories: Standard frame sizes, trip ratings and number of poles.
   1. Lugs: Mechanical style suitable for number, size, trip ratings and material of conductors.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

C. Enclosures in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise. Enclosures in exterior locations shall be NEMA 3R stainless steel, heavy duty.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.

B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.

C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb., white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office in Room 102, Storage Room north of Room 102, etc.). Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. If no school room number is assigned, list school name for room. List corridors as “corridor”. If unsure how to list rooms that may not have a number or name contact maintenance electrical supervisor or his designee. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7). All breakers controlled via contactors, or that supply control voltage to contactors shall be noted, and provide information at the bottom of directory card to include exact location of contactors, (example – plenum of Room 100) and how controlled (example – via BMCS). If breakers serve more than one contactor, the notations shall be separate for each contactor. Directory cards shall be large enough, including plastic holders, to include all necessary information. Directory cards are not to be folded to fit in holders. All breaker spaces are to be identified including for 2-pole and 3-pole breakers (list load on each space).

E. Fuses: Install fuses, of the ratings and class shown, in each power distribution and motor control panelboard.

F. Circuit Arrangement: Arrange branch circuit connections to 3-phase panelboards so that when two or three circuits are run with a common neutral, each circuit is connected to a different phase unless shown otherwise. Branch circuits shall be connected to the circuit breakers in the panelboard to provide the best possible phase balance, unless shown otherwise.

G. Panelboards not intended to be used as service entrance (SE) rated shall have the factory installed neutral to ground bonding screws and straps removed.

H. Spare Conduits: Provide (3) 1-inch conduits capped to 6-inches above accessible ceiling space all recessed panelboards.

I. Conductors shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Neutral and grounding conductors shall be installed similar to the phase conductors. Panelboard shall be cleaned of all construction debris prior to substantial completion review.

J. Circuit breakers and conductors installed for SPD devices shall be located at the top or bottom of the panelboard in respect to the location of the SPD device. Route all conductors to the SPD device using long sweep bends and the shortest conductor length possible.

K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to can with mechanical lugs and not to ground bus.

L. Install panels so that breaker number 1 is the top left breaker. Panel interiors shall not be installed where breaker number 1 is the bottom right breaker.

M. In panels that contain multi-layered neutral bus install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.

N. Label breaker mounting space with stick-on number labels.

O. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78 inches. Mount panelboards that are too high such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 ENCLOSED SWITCH AND CIRCUIT BREAKER INSTALLATION

A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.

B. Location: Provide safety switches within 50’ and in sight of motor served. There shall be minimum 3’ clearance in front of safety switch and a clear path in which to access wall mounted switches (ie.: not having to walk and/or stand on obstacles such as drain pans on floor to service).

C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of service panels or interfere with access areas. Provide

mounting hardware that will allow removal of safety and disconnect switches. Do not utilize drive pin anchors through enclosure.

D. Safety and Disconnect Switches: Install disconnect switches used with motor-driven appliances, motors and controllers within sight of the controller position unless indicated otherwise.

3.3 TESTING

A. Before energizing, energization, check for continuity of circuits and short circuits.

END OF SECTION

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Switchboard work as shown, scheduled, indicated, required, and specified.

1.2 QUALITY ASSURANCE

A. UL Labels: Provide switchboards UL labeled for service entrance and meeting requirements of UL 891.

B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB2, "Dead-Front Distribution Switchboards."

1.3 SUBMITTALS

A. Indicate:
1. Detailed dimensions for equipment foot print, front and side elevations.
2. Conduit entrance locations and requirements and restrictions.
3. Enclosure material, finish, and NEMA classification type.
4. Nameplate legends.
5. Size and number of bus bars
6. Switchboard instrument details.
7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Schneider Electric - Square D

B. General Electric Co.

C. Siemens

D. Eaton

2.2 MATERIALS AND COMPONENTS

A. Except as otherwise indicated, provide switchboard manufacturer's materials and components as indicated and as required for a complete installation.

2.3 DEAD-FRONT DISTRIBUTION SWITCHBOARDS

A. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

B. Provide a factory-assembled, dead-front construction, metal enclosed, self supporting, switchboard of voltage, phase, ampacity, and short circuit interrupting rating and bracing shown.
   1. Switchboard shall consist of the required number of front and rear aligned vertical sections bolted together to form one metal enclosed rigid switchboard. The switchboard shall be designed as a free-standing with only front access. Rear and/or side access only where indicated to reduce switchboard depth and where NEC required rear access clearance is available.
   2. Switchboard shall include protective devices and equipment shown with interconnections, instrumentation, and control wiring. Small wiring, necessary fuse blocks, and terminal blocks in the switchboard shall be provided. Groups of control wires leaving the switchboard shall be furnished with terminal blocks with numbering strips.
   3. Factory installed permanent lock-off provision for pad-locking in the off position for all protective devices.

C. Enclosure Construction: The switchboard framework shall be fabricated for floor mounting. The framework shall be formed code gauge steel, welded and bolted together to support cover plates, busing, and component devices.
   1. Each section shall have an open bottom and individually removable top plates for installation and termination of conduit. Top and bottom conduit areas shall be shown and dimensioned on the shop drawings. Front plates used for mounting meters, selector switches, or other front-mounted devices shall be hinged, with wiring installed and laced, and with flexibility at the hinged side. Closure plates shall be screw removable and small enough for easy handling by one technician.
   2. Weatherproof enclosure front door(s) shall be pad-lockable and suitable for the intended environmental conditions. When indicated or specified, rear doors shall also be pad-lockable.

D. Busing: The switchboard busing shall be copper.
   1. The bus bars shall be braced to comply with the integrated equipment rating of the switchboard. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit maximum available conduit entry area. The horizontal main bus bar supports, connections, and joints shall be bolted or welded, as required, so as not to require periodic maintenance. Bolted joint connections shall have at least two bolts per joint per phase. Half lapped bus joint construction is not acceptable.
   2. Buses shall be arranged A-B-C, left-to-right, top-to-bottom, and front-to-rear throughout. A ground bus shall be secured to each vertical section structure and extend the entire length of the switchboard.

3. The main horizontal bus and incoming line shall be isolated and insulated from outgoing busing and cable connections.
4. Each group mounted section shall have maximum full height bus. Where space is indicated, space shall be bused to install future switches or future circuit breakers sized as shown or a 600 Amp frame size circuit breaker or switch, whichever is greater.
5. The main horizontal bus shall be non-tapered, fully rated, extended and drilled for future additions and splice plates.

E. Integrated Equipment Rating: Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short circuit rating shall certify that equipment can withstand the stresses of a fault equal to that shown in RMS symmetrical amperes. Ratings shall have been established by actual tests by the manufacturer on similar equipment construction as the subject switchboard. This test data shall be available and furnished, if requested, with or before the submittal of shop drawings.

F. Indicating Instruments: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
2. Current, per phase RMS and 3 phase coverage.
3. Demand current per phase.
4. Power factor per phase and 3 phase average.
5. Real power, 3 phase total.
6. Reactive power, 3 phase total.
7. Apparent power, 3 phase total.
8. Frequency.
9. Average demand real power.
10. Adjustable demand interval (5 to 60 minutes).
11. Nonvolatile memory.
12. Password protected set-up and reset.
13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
14. Full scale readouts with the following accuracy:
    a. Current and voltage measurement +/-0.1%
    b. Power and energy +/-0.2%
    c. Frequency +/-0.5%
    d. Power Factor +/-1.0%
    e. Data update time 0.5 seconds (4 wire)
15. Metering Output.
    a. Pulse output based on kWh, kvarh, or kVAh.
    b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
16. Monitoring:
    a. Harmonic analysis through 63rd with THD and TIF.
    b. Event recorder.
    c. Waveform capture.
    d. Data logger.
    e. Triggered trace memory.
17. Communication:
    a. Front port and dual rear mounted RS485 ports.
    b. BACnet protocol (coordinate with BMCS contractor).
    c. Mini RTU: digital 4 in/4 out.
    d. Analog 1 in/4 out.

e. Local/remote display of all values.

18. Software:
    a. Windows based software shall be provided to enable setpoint programming.

G. The Main Protective Device(s) shall be individually mounted molded case circuit breaker(s):
1. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state true RMS sensing, without fusible elements, 100-percent continuous current rating.
2. Main protective devices with frame rated at 1000 Amps or greater shall have integral ground fault interrupter and provided with a portable test set or test switch.
3. Circuit breakers with 1,200 Amp frame and above shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
4. Provide shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.

H. Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
1. Molded case circuit breakers:
    a. Adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
    b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
    c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
2. Fusible switches:
    a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
    b. Fused switches 600 Amps and below, equipped for class J fuses.
    c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
    d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

I. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
1. Molded case circuit breakers:
    a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I^2t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
    b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
    c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
2. Fusible switches:
    a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
    b. Individual door over the front, equipped with a voidable interlock that

prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.

c. 600 Amps and below equipped for Class J fuses.

d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.

e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

J. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.

1. Ground fault protection shall be set at minimum setting for both current and time during construction. The switchboard manufacturer shall include in the submittal data for the switchboard, the minimum setting of the devices and the recommended setting for normal building operation.

2. The ground fault system shall be factory-tested before shipment as specified:

a. The switchboard manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of values indicated on the curve, the ground fault device shall be replaced or recalibrated.

b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.

c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

K. Mimic bus: Indicate busing, connections, and devices in single line form on the front panels of the switchboard using red colored plastic strips, fastened flat against the panel face with screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHBOARDS

A. Install switchboards where shown, in accordance with the manufacturer's written instructions, and industry practices to ensure that the switchboards meet the specifications. Provide weatherproof NEMA 3R enclosure housing outdoors, at wet locations, or where indicated on the drawings. Provide NEMA 3RX enclosure housing at corrosive locations of either aluminum or stainless-steel construction suitable for the intended environment when indicated on the drawings.

B. Comply with the requirements of NEMA and NEC, and NECA Standard of Installation, for installation of switchboards.

C. Where switchboard is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building’s grounding

system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the switchboard.

D. Torque bus connections and tighten mechanical fasteners.

E. Install fuses, of ratings shown, in each switchboard. Provide spare fuse cabinet with three fuses of each size provided. Locate in central plant as directed by Owner.

F. Concrete Pads: Install switchboards on a 4" reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the switchboard unless shown otherwise. Switchboard shall be bolted to the housekeeping pad using 3/8" minimum galvanized bolts and anchors on 30" maximum centers. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads to prevent delay of the concrete work.

G. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as recommended by the Fault Current and Coordination Analysis or as directed by the Engineer.

H. Indicating Instruments: Provide initial factory start-up and programming with Owner present. Integrate with the Building Management System for monitoring and logging of all system data.

3.2 TESTING

A. Notify Owner’s Commissioning Authority (CxA) prior to performing any tests so that the CxA may witness tests at the CxA’s discretion.

B. Pre-energization checks: Before energizing, check switchboards for continuous of circuits and for short circuits.

C. Switchboard insulation resistance test: Each switchboard bus shall be insulation resistance tested after installation is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-ground. Minimum acceptable value for insulation resistance is 2 megohms.

D. Ground Fault Interrupter (GFI) test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50 percent of overcurrent device rating or 1,200 Amperes, whichever is lower.

E. Provide thermal infrared scan of switchboard under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video disc (DVD) documentation with deficiencies corrected for comparison to future test.

F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.3 TRAINING

A. Provide minimum 2 hours of dedicated training provided by a factory authorized representative to Owner's personnel regarding programming, operating, and use of switchboard components including all indicating instruments and safety features.

END OF SECTION

SECTION 262716 - ELECTRICAL CABINETS AND ENCLOSURES

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cabinets and cutout boxes.
2. Termination boxes.
3. Miscellaneous enclosures.
4. Rack or frame systems.
5. Enclosure-mounted relocatable power taps.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Cabinets and cutout boxes.
2. Termination boxes.
3. Miscellaneous enclosures.
4. Rack or frame systems.
5. Enclosure-mounted relocatable power taps.

B. Shop Drawings:

1. Shop drawings for custom enclosures and cabinets.
2. Shop drawings for racks or frames.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Cabinets and cutout boxes.
2. Termination boxes.
3. Miscellaneous enclosures.
4. Rack or frame systems.
5. Enclosure-mounted relocatable power taps.

PART 2 - PRODUCTS

2.1 CABINETS AND CUTOUT BOXES

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. UL CCN CYIV.
b. Non-Environmental Characteristics: UL 50.
c. Environmental Characteristics: UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL CYIV - Outdoor Sheet Metal Cabinets :

1. General Characteristics: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
2. Options:

a. Degree of Protection: Type 3R.

2.2 MISCELLANEOUS ENCLOSURES

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. UL CCN XCKT; including UL 1773.
b. Non-Environmental Characteristics: UL 50.
c. Environmental Characteristics: UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data

illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Custom Enclosures and Cabinets: Include plans, elevations, sections, and attachment details.
2. Shop Drawings for Racks or Frames:

a. Include plans, elevations, sections, details, and attachments to other work.
b. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include workspace requirements and access for cable connections.
d. Grounding: Indicate location of RBB and its mounting detail showing standoff insulators and wall-mounting brackets.

3.2 SELECTION OF ELECTRICAL CABINETS AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of electrical cabinets and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

a. Type 3R unless otherwise indicated.
b. Locations Exposed to Hosedown: Type 4.
c. Locations Subject to Potential Flooding: Type 6P.
d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.

3.3 INSTALLATION ELECTRICAL CABINETS AND ENCLOSURES

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Cabinets and Cutout Boxes: Article 312 of NFPA 70.

2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Mount cabinets and enclosures at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
2. Do not install cabinets, enclosures, or fittings in contact with concrete or earth.
3. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
4. Identification: Provide labels for cabinets, enclosures, racks and associated electrical equipment.

    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each cabinet, enclosure, and rack with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

A. Remove construction dust and debris from cabinets, enclosures, and racks.

3.5 PROTECTION

A. Protect coatings and finishes of cabinets, enclosures, and racks from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 262716

SECTION 262773 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide wiring device work as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

A. UL Label: Wiring devices shall be UL labeled.

B. NEMA Standard WD1 and WD6

C. Fed. Spec. WC596, W-S-896

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Leviton, Mfg. Co., Inc.

B. Pass and Seymour, Inc.

C. Hubbell, Inc.

D. Cooper – Arrow Hart

E. Lutron, Inc. (Dimming)

2.2 WIRING DEVICE COLOR

A. Device color shall be white except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red. Verify with Architect prior to submitting for approval.

2.3 RECEPTACLES

A. Commercial grade receptacles, NEMA configuration indicated.
   1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #16352 or equal
   2. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R: Leviton #7898 or equal
   3. Provide weather resistant (WR) receptacles at all exterior locations

2.4 WALL SWITCHES

A. Toggle: Commercial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
   1. Single-pole, 120/277V, 20A switch: Leviton #54521 or equal
   2. Double Pole 120/277V, 20A switch: Leviton #54522 or equal
   3. Three-way, 120/277V, 20A switch: Leviton #54523 or qual

4. Four-way, 120/277V, 20A switch: Leviton #54524 or qual

B. Local relay switch for remote control low voltage switching systems:
1. Single-pole, double throw, center off, 120/277V, 15A momentary switch: Hubbell #HBL-1556 or equal

2.5 WALL DIMMERS

A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with a positive OFF position at the end of travel. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 130V.
1. Single-pole, 120V, 1000 watt incandescent: Lutron #N-1000-X.
2. Single-pole, 120V, 2000 watt: Lutron #N-2000-X.
3. Single-pole, 120V, 16A for Lutron Electronic Dimming Ballast, Lutron #NF-10-X.
4. Single-pole, 277V, 8A for Lutron Electronic Dimming Ballast, #NF-10-277.
5. Three way, four way, Lutron to match above.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

2.7 INTERIOR WALL COVER PLATES

A. Smooth finish, molded of high impact nylon.
1. Plate color shall match device and/or toggle color.
2. Fastening screws shall match plate color.

2.8 EXTERIOR RECEPTACLE COVER PLATES

A. Thomas & Betts CKSUV, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All wiring devices for receptacles and wall switches shall be of the same manufacturer throughout unless otherwise noted.
1. Lutron dimming controls shall be used with Lutron dimming electronic ballast.

B. Install wiring devices where shown, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.

C. Install receptacles and switches only in electrical boxes that are clean, free from excess building materials, debris, and similar matter.

D. Install wiring devices plumb and aligned in the plane of the wall, floor, or ceiling in where they are installed.

E. Install switches in boxes on the strike side of doors as hung. Verify door swing ogf all doors prior to rough-in. Install a uniform position so the same direction will open and close the circuit throughout the project. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.

F. Provide a plate for every receptacle, switch, telephone outlet and other wiring devices

G. Mounting heights of all wiring devices shall comply with current Accessibility Standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.

H. Refer to Architectural drawing, elevations, etc. for exact location of wiring devices where indicated on the Architectural plans. Coordinate location of all wiring devices with other specialty items and millwork and avoid conflicts. Coordinate with all trades to avoid conflicts during construction.

I. Provide weatherproof and weather resistant (WR) GFCI, 20A, 125V duplex receptacles outdoors where indicated and within 25’ of all new electrically operated equipment mounted outdoors and on roofs.

J. Install wall box dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.

K. Do not share neutral conductor on dimming circuits.

L. Install receptacles with grounding pole down, or as directed by Owner. If installed horizontally, install with neutral on top.

M. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

N. Connect wiring devices by wrapping ground conductor around screw terminal or inserting into mechanical lug. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap neutral and phase conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.

O. Provide nameplate engraving for emergency outlets at locations indicating panelboard and circuit number.

3.2 TESTING

A. Before energizing, check for continuity of circuits, short circuits, and grounding connections. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization. Test GFCI receptacle operation with simulated ground fault tester.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

END OF SECTION

SECTION 262900 - MISCELLANEOUS ELECTRICAL CONTROLS & CONTROL WIRING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Miscellaneous electrical controls and control wiring work is as shown and scheduled, and as specified.

B. Types: Miscellaneous electrical controls and control wiring specified in this Section include, but are not limited to, the following:
   1. Miscellaneous Electrical Controls:
      a. Photo Sensors
      b. Time switches.
   2. Miscellaneous Control Wiring:
      a. Stop-start stations and inter-connecting and interlock wiring for motors, controllers, air-cooled condensing units, interlocks, safety devices, and similar items.
      b. Capacitor control wiring.
      c. Additional control wiring and safety devices as shown and specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Provide products produced by one of the following:
   1. Time Switches and Photo Sensor
   2. Intermatic Time Controls
   3. Tork
   4. Paragon
   5. Grasslin

2.2 INTERIOR AND EXTERIOR LIGHTING CONTROL

A. Photo Sensors: Self-contained, adjustable, weatherproof Photo Sensor designed for mounting on an outdoor junction box.

B. Time Switches: Tork #DLC 400 Seven-day four-zone digital electronic time switch with integral photo sensor with 40-year memory feature. Time switches shall be installed in flush or surface mounted NEMA enclosure as required.

C. Control Relays: As required for control of lighting contactors.

2.3 WIRING AND RACEWAYS

A. Line Voltage Control Wiring: As specified in Section 16120.

B. Low Voltage Control Wiring: As specified in Section 16120, except that conductors shall consist of a multi-conductor jacketed cable whenever possible.

C. Raceways: Raceways for line voltage and low voltage control wiring shall be as specified in Sections 16110 and 16130.

PART 3 - EXECUTION

3.1 INSTALLATION OF MISCELLANEOUS ELECTRICAL CONTROLS

A. Install miscellaneous electrical control devices as required, in accordance with NECA Standard of Installation, and industry practices.

B. Conductors: Connect electrical conductors to miscellaneous electrical control devices in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, match conductors of the electrical enclosures as shown; ensure they are complete, including control wiring and devices.

C. Photo Sensors and Time Switches: Photo Sensor and time switch settings shall be as directed by the Owner.

D. Line and Low Voltage Control Wiring: Line and low voltage control wiring shall be installed in a suitable raceway.

E. Connections: Refer to Section 16121 for connections to equipment.

END OF SECTION

SECTION 265113 - LIGHTING FIXTURES & LAMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Work Included: Lighting fixture work is as shown, scheduled and specified.

B. Applications: The applications of lighting fixtures required for the project include the following:
   1. General lighting
   2. Emergency lighting
   3. Outdoor area lighting

1.2 QUALITY ASSURANCE

A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC listed as a Qualifying Product at time of proposal submittal date.

B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.

C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.

B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for approved light fixture manufacturers.
   1. Emergency Battery Packs:
      Bodine
      IOTA
      Chloride
      Lithonia
      Dual Lite
   2. Emergency Generator/Inverter Load Control Bypass Relay; UL924 listed and 0-10Vdc compatible:

Bodine
Wattstopper
Hubbell
Iota
Nine 24, Inc.

3. Emergency Generator / Inverter Branch Circuit Transfer Switch, UL 1008 listed and 0-10Vdc compatible:
Bodine GTD20A
ETC SC1008

2.2 MATERIALS AND COMPONENTS

A. General: Provide lighting fixtures of the size, type, and rating indicated, complete with, but not limited to, lamps, lamp holders, reflectors, ballasts, starters, and wiring.

B. Fixture Types:
1. General:
   a. Lay-in troffer fixture panel type lenses, where specified, shall be extruded virgin acrylic, prismatic type minimum 0.125" thick, 7.8-ounces per square foot minimum.
   b. Fixtures in continuous rows shall be supplied with fixture couplings, chase nipples, and accessories recommended by the manufacturer for continuous row installation.
   c. Safety chains and wire guards at fixtures in mechanical and electrical rooms, gymnasiums and high abuse areas.
   d. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
   e. Fixture door frame shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
   f. DLC or Energy Star qualified unless specified otherwise.
   g. Minimum 5-year replacement warranty for driver and light engine.
   h. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
   i. Operating temperature rating shall be between -40 degrees F and 120 degrees F.
   j. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
   k. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed. Downlight fixtures shall have a minimum efficiency of 65-percent and exhibit “lamp before lamp image” 45-degree cutoff for ceiling up to 10 feet.
3. LED Exit Signs: The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
   a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafetoriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.

4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
5. All gymnasium light fixtures, acrylic or glass surfaces, shall be vandal proof with wire guards to protect lens and/or refractor.

C. LED drivers:
1. NEMA 410 compliant for in-rush current.
2. Drivers shall have a minimum efficiency of 85%.
3. Starting Temperature: -40˚ F [-40˚ C].
4. Input Voltage: 120 to 480 (±10%) V.
5. Power Supplies: Class I or II output.
6. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
7. Power Factor (PF): ≥ 0.90.
8. Total Harmonic Distortion (THD): ≤ 20%.
9. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
10. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipmenton 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.

E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.

F. Emergency LED battery self testing drivers and inverters; 5 year warranty.
1. Bodine BSL-ST Series for OEM installation
2. Bodine BSL310-SI Series for field installation
3. Bodine ELI-S Series for line voltage sine wave inverter field installation

G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.

H. Emergency Generator / Inverter Load Control Device:
1. 16 Amp minimum ballast / driver load
2. Compatible with 0-10 Volt dimmer switches
3. UL 924
4. Minimum 3-year warranty
5. Integral or remove test switch.

I. Emergency Generator / Inverter branch circuit transfer switch:
1. UL 1008
2. 20 Amp ballast/driver load
3. 0-10Vdc dimming compatible

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights

in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.

B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.

C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.

D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.

E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner’s designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.

F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafetoriums and kitchens.

G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.

H. Install in accordance with manufacturers instructions.

I. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.

J. Locate recessed ceiling luminaries as indicated on the Architectural reflected ceiling plan.

K. Install surface mounted luminaries plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

L. Exposed Grid Ceilings: Support surface mounted luminaries on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface mounted luminaries. Fasten surface mounted luminaries to ceiling T using bolts, screws, rivets, or suitable clips.

M. Install recessed luminaries to permit removal from below.

N. Install recessed luminaries using accessories and fire stopping materials to meet regulatory requirements for fire rating.

O. Install wall-mounted luminaries at height as directed by Architect.

P. Install accessories furnished with each luminary.

Q. Connect luminaries to branch circuit outlets using flexible conduit as specified.

R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaries.

S. Bond products and metal accessories to branch circuit equipment grounding conductor.

T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.

U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency transfer devices (GTD). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or GTD circuit shall originate from same branch circuit breaker as switched lighting circuit.

V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.

W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.

X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Where no building management system is provided or specified, provide time clock switches, photocells, photosensors as specified, and required by the local energy codes.

Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.

Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.

AA. Lighting Fixture Supports:
1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.

BB. Hardware for surface mounting fixtures to suspended ceilings:
1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture.

Pre-positioned 1/4 inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4 inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.

3.2 TESTING

A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.

B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.

C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

SECTION 265613 - LIGHTING POLES AND STANDARDS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.
4. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Material Test Reports:

1. For each foundation component, by a qualified testing agency.
2. For each pole, by a qualified testing agency.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample Warranty: Manufacturer's standard warranty.

F. Soil test reports

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B660.

B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified

warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

D. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

E. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
    a. Wind Importance Factor:1.0 .
    b. Minimum Design Life: 25 years.
    c. Velocity Conversion Factor: 1.0.

G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6063-T6, with access handhole in pole wall.

1. Shape: Round, tapered.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Mast Arms: Aluminum type, continuously welded to pole attachment plate. Material and finish same as plate.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.

2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Fasteners: Stainless steel , size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

I. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.
    a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.

2.8 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.9 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55**,** with a minimum yield strength of 55,000 psi.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Bent rods.
3. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A563, Grade A, Heavy-Hex.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.

C. Washers: ASTM F436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.

2.10 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

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

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches.
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-

wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified inspector to perform the following inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.

END OF SECTION 265613

SECTION 265619 - LED EXTERIOR LIGHTING

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Luminaire-mounted photoelectric relays.
2. Luminaire types.
3. Materials.
4. Finishes.
5. Luminaire support components.

B. Related Requirements:
1. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-80.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient

Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which equipment and luminaires will be attached.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Source quality-control reports.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: **5** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for

indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598.

G. CRI of minimum80. CCT of 4000 K.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Source Limitations:

1. Obtain luminaires from single source from a single manufacturer.
2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15- second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

C. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

D. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

E. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

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

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.

Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wiring Method: Install cables in raceways. Conceal raceways and cables.

G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

H. Coordinate layout and installation of luminaires with other construction.

I. Adjust luminaires that require field adjustment or aiming.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 ORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Luminaire will be considered defective if it does not pass tests and inspections.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619

SECTION 270010 - SUPPLEMENTAL REQUIREMENTS FOR COMMUNICATIONS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 27.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for abbreviations and acronyms for electrical terms and units of measure, abbreviations and acronyms for electrical raceway types, abbreviations and acronyms for electrical cable types, and additional coordination drawing submittal requirements.

1.2 REFERENCES

A. Abbreviations and Acronyms for Communications:

1. PoE: Power over Ethernet.
2. TCP/IP: Transmission control protocol/Internet protocol.

1.3 PREINSTALLATION MEETINGS

A. Communications Preconstruction Conference: Schedule conference with Architect and Owner not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:

1. Installation schedule for communications systems.
2. Commissioning activities.

1.4 ACTION SUBMITTALS

A. Coordination Drawings: Submit multidiscipline coordination drawings depicting communications equipment, devices, cabling, conduit, and duct banks in accordance with requirements specified in Section 260010 "Supplemental Requirements for Electrical."

1.5 INFORMATIONAL SUBMITTALS

A. Installation Schedule for Communications Systems: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for installation of communications Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of specified coordination drawings.

2. Submission of action submittals specified in Division 27.
3. Preinstallation meetings specified in Division 27.
4. System startup, testing, and commissioning activities for communications equipment.
5. System startup, testing, and commissioning activities for Work specified in other divisions that depends on Work specified in Division 27.
6. Requests for special inspections.
7. Requests for inspections by authorities having jurisdiction.

B. Qualification Statements:

1. For qualified regional manufacturer.
2. For communications design professional.
3. For communications cable Installer.
4. For communications testing agency and on-site communications testing supervisor.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:

   a. Cellular modem.
   b. Horizontal distribution system.

2. Include the following information:

   a. Manufacturer's operating specifications.
   b. Detailed instructions covering operation under both normal and abnormal conditions.

1.7 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Communications Design Professional: Design professional possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:

1. Expertise in design of communications infrastructure and distribution equipment.
2. BICSI Registered Communications Distribution Designer (RCDD) certification.

C. Communications Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:

1. Training and manufacturer certification to install, splice, and terminate communications cabling.

2. Installation Supervisor: BICSI Technician (TECH) certification.
3. Copper Installers: 30 percent of employees possess BICSI Copper Installer 2 (INSTC) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.

D. Communications Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site communications testing supervisor must have BICSI Technician (TECH) certification and documented training, and be experienced with testing communications equipment in accordance with BICSI testing standards.

1.8 FIELD CONDITIONS

A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 27 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR COMMUNICATIONS EQUIPMENT

A. Substitution requests for communications equipment will be entertained under the following conditions:

1. Substitution requests may be submitted for consideration prior to the Communications Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
2. Contractor is responsible for sequencing and scheduling equipment procurement. After the Communications Preconstruction Conference, insufficient lead time for equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.2 INSTALLATION OF COMMUNICATIONS WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' instructions, comply with NFPA 70, NECA NEIS 1, and BICSI N1 for installation of Work specified in Division 27. Consult Architect for resolution of conflicting requirements.

3.3 FIELD QUALITY CONTROL

A. Administrant for Communications Tests and Inspections:

1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

END OF SECTION 270010

SECTION 270100 - OPERATION AND MAINTENANCE (O&M) MANUALS OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Compile product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified in this Section and as referenced in other sections of specifications.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three (3) electronic copies, on separate devices (USB Flash Drive or some type of pre-approved solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer’s operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.

D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.

E. Recorded video of all training sessions shall be included in each copy, of each system’s final submitted O&M.

F. The final submitted manual shall include a sing-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant’s stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System’s O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:

1. Table of Contents for each element
2. Contractor information
3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant’s stamp of acceptance.
4. All parts and maintenance manuals for items of equipment
5. Warranties (without starting dates)
6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
7. Operating and maintenance procedures.
8. Form of Owner's Training Program Syllabus (including times and dates)
9. Control operations / equipment wiring diagrams
10. Coordination Drawings
11. Schedule of Speakers, Amplifiers, Sound Equipment, Etc.
12. Schedule of Handsets and other Peripheral Devices, Etc.
13. Schedule of Cable, Jacks, Outlets, Etc.
14. Access Control Door Schedules
15. Video Surveillance Camera Schedules

16. Other required operating and maintenance information that are complete.
17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.

D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.

F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
2. Minimum ring size: 1"; Maximum ring size: 3".
3. When multiple binders are used, correlate the data into related groupings.
4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals Submitted in Hard Copy Format:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
   a. Size: 8-1/2" x 11"
   b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
   a. Provide reinforced punched binder tab and bind in text.
   b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
   a. Title of Project
   b. Identity of separate structures as applicable

c. Identity of general subject matter covered in the manual.

6. Binder as specified

B. Content of Manual:

1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
   a. Contractor, name of responsible principal, address and telephone number
   b. A list of each product required to be included, indexed to content of the volume.
   c. List with each product, name, address and telephone number of:
      1) Subcontractor or installer
      2) Maintenance contractor as appropriate
      3) Identify area of responsibility of each.
      4) Local source of supply for parts and replacement
   d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
   a. Include those sheets pertinent to the specific product.
   b. Annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems
      2) Control and flow diagrams
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
4. Written text as required to supplement product data for the particular installation:
   a. Organize in consistent format under separate headings for different procedures.
   b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure
      2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems

1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts:
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine / normal operating instructions
      2) Regulation, control, stopping, shut down and emergency instructions
      3) Special operating instructions
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting
      3) Disassembly, repair and reassembly

4) Alignment, adjusting and checking
5) Routine service based on operating hours

d. Manufacturer's printed operating and maintenance instructions.
e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
f. Complete equipment field accessible wiring diagrams
g. Each Contractor's coordination drawings
h. Other data as required under pertinent sections of the specifications

2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 27.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

END OF SECTION

SECTION 270500 - COMMUNICATIONS BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 27 Communications.

B. Applicable provisions of this section apply to all sections of Division 27, Communications.

C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
1. Division 26 in its entirety.
2. Division 27 in its entirety.
3. Division 28 in its entirety.

D. The entire drawing and specification package apply to the work specified in the communication specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.2 CODES AND STANDARDS

A. All equipment and work performed shall comply with current and applicable Codes, Standards, Rules, Ordinances, Regulations, and Best Practices (both published and best practices) as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities (including those not specifically listed in this Specification). Applicable Codes and Standards shall consist of, but not be limited to the following:
1. Americans with Disabilities Act (ADA)
2. Authorities Having Jurisdiction (AHJ) - Local
3. American National Standards Institute (ANSI)
4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
5. Building Industry Consulting Services International (BICSI)
6. Code of Federal Regulations - Title 47
7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
11. International Electro-technical Commission (IEC)
12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core*

and LAN/MAN Core Equivalents-11801, 8802, 14763-1

14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
16. National Electrical Contractor's Association (NECA) *Standards of Installation*
17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
18. National Electrical Safety Code (NESC)
19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
20. Society of Cable Telecommunications Engineers (SCTE)
21. Local Accessibility Standards
22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
23. Uniform Building Code (UBC)
24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*

B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

D. Obtain all permits required.

1.3 SUMMARY

A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.

C. Provide complete and working Communications Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The Communications Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All Communications Systems plans, and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR’S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
   a. Licenses, as applicable to the system being installed
   b. Manufacturer's Certifications
      1) Firm Certification
      2) Installer Certification
      3) Programmer's Certification
      4) System Designer Certification.

1.5 DRAWINGS AND SPECIFICATIONS

A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Consultant for review. No departures shall be made without prior written acceptance of the Consultant.

C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Consultant in writing, shall be performed or furnished. In the case that the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large-scale details govern small scale drawings.

D. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.

H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.

I. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the project's consultant of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.

J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes, ordinances, and standards; as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Consultant. The Consultant reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.

D. In areas of existing special ceiling construction, the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.

B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3” beyond the finished surface. In pipe chases, they shall extend 8” inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio.1/2 inch greater than outside diameter of the conduit.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
   1. Make final connections to all communications equipment indicated on the drawings, except as noted.

F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to

produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 27 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.

C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work:
1. Obtained from utility maps and other substantially reliable sources.
2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.

B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CATV	Cable Antenna Television
CCTV	Closed Circuit Television
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
FACP	Fire Alarm Control Panel

FCR	Floor Communications Room
Gbps	Giga Bits Per Second
Hz	Hertz
IC	Intermediate Cross-connect
IDF	Intermediate Distribution Frame
IM	Information Management
IS	Information Systems or Information Services (also see MIS)
IT	Information Technology
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MATV	Master Antenna Television *(A.K.A. Main Antenna Television)*
Mbps	Mega Bits Per Second
MC	Main Cross-connect
MDF	Main Distribution Frame
MHz	Megahertz
MIS	Management Information Systems or Services
NEXT	Near-End Cross Talk
nm	Nanometer
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
PBX	Private Branch Exchange
POS	Point of Sale
PSELFEXT	Power Sum Equal Level Far-End Cross Talk
PSNEXT	Power Sum Near-End Cross Talk
SMATV	Satellite Main Antenna Television
TC	Telecommunications Closet *(Now referred to as TR)*
T.O.	Telecommunications Outlet
TR	Telecommunications Room *(A.K.A. TC - Telecommunication Closet)*
UTP	Unshielded Twisted Pair Wire

Definitions:

Administration Subsystem - Cable, connectors, cross-connect and inter-connect hardware, patch cords, and other equipment that allows easy reconfiguration of the telecommunications system to accommodate personnel and floor plans changes.

Campus Backbone Subsystem - Connects telecommunications processing equipment in different buildings on the same campus.

Communications Cabling - Any fiber optic, copper, coaxial or other transmission media used for transmitting or receiving communications systems data.

Communications System - Communications Systems and associated wired or wireless interconnection.

Communications Drawings - All floor plans, elevations, details, schematics, block diagrams, legends, tables, notes or attachments associated with any or all of the Communications Systems.

Distribution Cable - The telecommunications UTP wiring between the telecommunications room and the outlet connectors.

Equipment Subsystem - Telecommunications cable, connectors, support hardware, blocks, and protective devices that serve to connect the network interface and the backbone subsystem through the administrative subsystem.

Horizontal Subsystem - Telecommunications cable, outlets and distribution cords that extend the riser backbone from the administrative points in the TRs to workstations.

Information Systems - Software systems including operating systems, programs, data manipulation and management systems, control software and various forms of proprietary and off-the-shelf software.

Information Technology - The practical application of knowledge associated with designing, installing and maintaining the equipment, hardware and infrastructure utilized for control, distribution, or display of telecommunications, audio, video and data signals. Because computers are central to information management, computer departments within companies and universities are often called (IT Departments) and are responsible for MIS or IS personnel and services.

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the Communications Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the Communications Systems operational or for system communications.

Management Information Systems - A class of software that provides managers with tools for organizing and evaluating their department. Typically, MIS systems are written in COBOL and run on mainframes or minicomputers. Within companies and large organizations, the department responsible for computer systems is sometime called the MIS department. Another name for MIS is Information Services (IS).

Multiplexer - A communications device that multiplexes (combines) several signals for transmission over a single medium. A multiplexer is sometimes called a "mux". A demultiplexer is required to complete the process by separating multiplexed signals from a transmission line. Frequently a multiplexer and demultiplexer are combined into a single device capable of processing both outgoing and incoming signals.

Riser Backbone Subsystem - Telecommunications cable, splice enclosures, and associated hardware that provide the main cable routes in a building. It interconnects building floors and larger areas of a single floor. It also interconnects administrative points in satellite TRs to the administrative points in the building main equipment room.

Station Cable - The wiring between the outlet connections and the work area equipment.

Communications Systems - One or more of the following and associated equipment: Data/Networking Systems, Telecommunications Systems, Paging / Intercom Systems, Clock/Control Systems, Master Antenna Television Systems, Cable Antenna Television Systems, Broadcast Video Systems, Audio/Visual Presentations Systems, Microwave/Wireless Systems.

Telecommunications - The transmission, emission or reception of signs, signals, images,

sound or intelligence of any nature by wire, radio, optical or other technical transmission system.

Work Area - Location of an employee or student and their data/telecommunications equipment or devices.

Work Area Subsystem - Station mounting cords, extension cords, connectors, adapters, and interface units that provide physical and electrical connectivity between workstation equipment and the horizontal subsystem.

1.16 QUALITY ASSURANCE

A. Equipment Standards:
1. System and all components shall be brand new stock from manufacturer.
2. All electronics shall be 100% solid state.
3. System and all components shall bear a UL Label.

B. Contractor Qualifications:
At the time of Proposal, the Contractor shall:
1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.
4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

A. Provide SUBMITTALS according to Division 01 and the following.

B. Requirements:
1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
2. Submit proof that all system components and cables are U.L. Listed.
3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
4. Product technical information sheets for each principal component in the proposed system, including cable, wire, terminal marking, and wire marking material.
5. Certification from the manufacturer stating that the system Contractor is an authorized

distributor or installer of the proposed system when such certifications exist.

6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.

B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.

B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under-slab cables installed, dimensioning exact location and elevation of such installations.

B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014 or later / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
   1. 3 sets of electronic AutoCAD (2014 dwg or later) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
   2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
   3. Three sets of blue or black-line prints of each contract as-built drawing.

C. As-Built Drawings should indicate the following information as a minimum:
   1. Indicate all addendum changes to documents.
   2. Remove Engineer's Seal, name, address, and logo from drawings.
   3. Mark documents AS-BUILT DRAWINGS.
   4. Clearly indicate: DOCUMENT PRODUCED BY:
   5. Indicate all changes to construction during construction. Indicate actual routing of all conduit and cables, etc that were deviated from construction drawings.
   6. Indicate exact location of all underground communications raceways, and elevations.
   7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
   8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
   9. Exact location of all communications equipment in building. Label panel schedules to indicate actual location.
   10. Exact location of all communications equipment in and outside of the building.

11. Location, size and routing of all communications cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
13. Cloud all changes.

1.26 OPERATING TESTS

A. After all communications systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.27 WARRANTY

A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.

B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

A. General: Refer to Division 01 for general requirements on temporary facilities.

B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.

C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.3 STANDARD PRODUCTS

A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.4 MANUFACTURE’S INSTRUCTIONS

A. The Contractor is responsible for furnishing the proper Communication equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Consultant.

2.5 RUST PREVENTION

A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.6 STORAGE AT SITE

A. The Contractor shall not receive material or equipment at the job site until ready for

installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.

C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

A. All materials required for the installation of the Communication systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
   1. Plaster Surfaces: Milcor Style K.
   2. Ceramic Tile Surfaces: Milcor Style M.
   3. Drywall Surfaces: Milcor Style DW.
   4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.

B. Aesthetics are an important consideration in this installation. All components shall be installed

so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.

C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.

D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.

E. If appropriate, interfaces with the Owner's Data Network, Telecommunications and Communications System shall be coordinated with the Owner and Architect.

F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.

G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.

H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.

I. Ground busses shall be provided in each any room with communication equipment.

J. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.

K. Communications grounding system shall be a single point grounding from the building entrance electrical ground to each Communications room.

L. All Conduit systems, cabinets’ racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common communications grounding system. The conductors shall be a # 6awg solid with a green jacket

M. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.

N. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation if applicable, the more stringent shall apply.

O. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.

P. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.

Q. The installation shall be performed in a professional manner.

R. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.

S. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.

T. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

U. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.

B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.

B. All wires in exposed areas shall run through conduit as specified in Division 26.

C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.

D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.

E. Run wires continuously from termination to termination without splices.

F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal

and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at not rime shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.

G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2” or larger sized conduits.

H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.

I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). Communications cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.

J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.

B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all Communications Systems wiring.

C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.

D. Identification of Equipment:
   1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
   2. A black-white-black 3 layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and communications (voice, data, video) cabinet or rack.
      a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and ¼-inch letters indicating source circuit

designation, (i.e.: “IDF(FCR) XXYY –served from MDF (BCR) XXGG).

3. Permanent, waterproof, black markers shall be used to identify each communications grid junction box, clearly indicating the type of system available at that junction box.
4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
5. Communication hardware located above accessible ceilings: Provide ½-inch high black name plate with white 1/4-inch letters glued to bottom of t-grid ceiling below hardware located above ceiling. Identification shall be as short as possible yet identifying device above ceiling, i.e. “A/V-EQ”.

E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of communications facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.

H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried communications lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the communications systems.
1. Provide the training during regular working day.
2. The Instructors shall be experienced in their phase of operation and maintenance of the systems and with the project.

C. Time to be allocated for instructions.

The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include training as specified per system specification,

1. Minimum of four (4) hours dedicated instructor time
2. 2-hour sessions on different, non-consecutive days
3. Additional instruction time for specific systems as specified in other Sections.

D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
   1. One copy to the Owner
   2. One copy to the Architect / Engineer

E. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.

F. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

G. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.

H. Demonstrate equipment functions (both individually and as part of the total integrated system).

I. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

J. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.

K. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

L. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
   1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.

2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each communications location.

3.13 SITE MANAGEMENT RESPONSIBILITY

A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR’S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.

B. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant and await

reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at no additional cost to the Owner or the Consultant.

C. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work ad in accordance with standard practice of the trades involved.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Consultant.

3.15 EXISTING SYSTEM TESTING

A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 27 umbrellas, as identified in the Division 27 of the Construction Specifications Institute (CSI) current Master Format . Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.

B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.

C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.

D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all Communications Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect’s judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer’s factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.

B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.

C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
   1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
   2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.

B. All materials shall be neat, clean and unmarred, and parts securely attached.

C. All extra material as specified shall be delivered and stored at the premises as directed.

D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.

B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
   1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
   2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
   3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that cam in the original shipping container for that piece of equipment. Include all warranty cards.

C. Testing:
   1. The Contractor shall perform all tests required by Division 26 and those submitted as part of this Section.
   2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
   3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.

D. As-Built Drawings:
   1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
   2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.

E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
   1. System Operations and Maintenance Manuals
   2. System Test Reports
   3. As-Built Drawings

3.19 FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements

B. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

SECTION 270507 - COMMUNICATIONS SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 01 and as outlined below.

B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.

C. The term submittal, as used herein, refers to all:
1. Shop Drawings
2. Coordination Drawings
3. Product data

D. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each room containing technology equipment and each rack with technology equipment, submit plan and elevation drawings. Show:
1. Actual technology equipment and components to be furnished.
2. NEC working space and NEC access to NEC working space.
3. Relationship to other equipment and components and openings, doors and obstructions

4. Rack location and dimensions

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Verify location of communications station devices, telephone outlets and other work specified in this Division.
1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.

F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
1. Field measurements
2. Field construction criteria
3. Manufacturer's catalog numbers
4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
2. That the item will fit in the available space in a manner that will allow proper service
3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
1. Date
2. Project title and number
3. Contractor's name, address and telephone number
4. The number of each Shop Drawing, Project Datum and Sample submitted
5. Other pertinent data

D. Submittals shall include:
1. The date of submission
2. The project title and number
3. Contract Identification
4. The names of:
    a. Contractor
    b. Subcontractor
    c. Supplier
    d. Manufacturer
5. Identification of the product

6. Field dimensions, clearly identified as such
7. Relation to adjacent or critical features of the work or materials
8. Applicable standards, such as ASTM or federal specifications numbers
9. Identification of deviations from contract documents
10. Suitable blank space for General Contractor and Architect / Engineer stamps
11. Contractor's signed and dated Stamp of Approval

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
1. The related specification section number
2. The exact specification section title

B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make resubmittals under procedures specified for initial submittals.
1. Indicate that the document or sample is a resubmittal
2. Identify changes made since previous submittals

B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:

1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
3. Return submittals to Contractor for distribution or for resubmission

B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

A. Submittals shall not be combined or bound together with any other material submittal.

B. Submit individually bound shop drawings and product data for the following when specified or provided:
1. Structural Cabling
2. Communications System
3. Sound Reinforcement System
4. CATV System

3.2 COORDINATION DRAWINGS

A. Submit coordination drawings as specified.

END OF SECTION

SECTION 270509 - CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide a manufacturer’s qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing and adjusting of equipment.

B. Manufacturer’s qualified personnel shall make written report of observations and

recommendations to Architect/Engineer.

1.7 MOCK UPS

A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.

B. Do not proceed with any work involving a mock-up, until the related mock up has been approved in writing.

C. Acceptable mock-ups in place shall be retained in the completed work where possible.

D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
   1. Rough-in
   2. Finish with all appurtenances in place
   3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

A. Mock-up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Underground-line warning tape.
2. Bands and tubes.
3. Cable ties.
4. Miscellaneous identification products.
5. Labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for communications identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester flexible labels with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels:

    a. Permanent, waterproof black ink marker recommended by tag manufacturer.
    b. Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.

2.5 UNDERGROUND-LINE WARNING TAPE

B. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

C. Color and Printing:

1. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, and ANSI Z535.4.

2.6 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

3. Provide label 6 inches from cable end.

G. Snap-Around Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches from cable end.

H. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches from cable end.

I. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- \ high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

J. Snap-Around, Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

K. Underground-Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

L. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.

C. Cables: Label each cable with a vinyl-wraparound label indicating the location of the far or other end of the cable.

D. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.

END OF SECTION 270553

SECTION 271005 - STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Provide a complete and tested Category 6 / 6A structured cable system (SCS) for data and analog voice interconnections (Local Area Network). The structured cable system shall include fully terminated fiber optic and copper twisted pair cables, raceways, conduit, UTP termination devices, data communications outlets, patch panels, patch cables, racks, multi-media cabling connectors and cables, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.

B. Provide MDF to IDF fiber optic cable interconnections. The fiber strands shall be terminated and clearly marked on each IDF and MDF patch panel.

C. Provide and locate all IDFs as required for a complete system. Additional IDF locations must be approved. Locate in Mechanical/Electrical type room. Contractor is responsible for any additional power requirements.

D. The Contractor shall coordinate with other system vendors, where appropriate, to facilitate equipment installation, scheduling, protection of equipment and access to the project site in order to provide the Owner a substantially complete project in a timely manner.

E. Network electronics equipment shall be furnished by the Owner.

F. Provide media presentation connectivity where indicated, specified or required.

1.2 QUALITY ASSURANCE

A. Installer Qualifications:
   1. The Structured Cable System Installer shall be licensed and shall meet all applicable regulations. The Contractor shall be a member of BICSI and a firm normally employed in the low voltage and data cabling industry.
   2. The contractor shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein, and have a minimum of five (5) years' experience on similar SCS cabling systems.
   3. The contractor must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
   4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and metallic premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
   5. A resume of qualifications shall be submitted with the Contractor's proposal indicating the following:
      a. A list of five recently completed projects of similar type and size with contact names and telephone numbers for each.

b. A list of test equipment proposed for use in verifying the installed integrity of metallic and fiber optic cable systems on this project.
c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who shall be assigned to this project.
d. A list of technical product training attended by the contractor's personnel that shall install the SCS system shall be submitted.
e. Any subcontractor who shall assist the SCS contractor in performance of this work shall have the same training and certification as the SCS contractor.

6. The Proposer without use of sub-contractors shall install the entire Data Cable system. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full time factory certified employed service staff for product support and service.

B. The Contractor shall attend a mandatory pre-construction meeting with individuals deemed necessary by the Owner's representative prior to the start of the work.
1. T568A and T568B are the two wiring standards for an 8-position modular connector, permitted under the TIA-568 wiring standards document. Provide T568B unless directed otherwise by the Owner / Architect. Coordinate with owner correct color pair termination prior to final terminations.
2. Items requested by the Owner/Architect to finalize rack equipment configuration, rack cable management, rack cable terminations and other miscellaneous minor changes shall become part of the Contract Documents as supplementary information.

C. The products specified in Part 2 of this Specification shall be supplied by a single manufacturer, with the exception of 1) data racks and other hardware that is not defined as part of the channel test configuration by TIA/EIA TSB67, Transmission Performance Specifications for Field Testing of unshielded Twisted-Pair Cabling Systems; 2) Outside plant (OSP) copper cable. Manufacturer shall have a minimum of seven (7) years' experience and shall be ISO 9001 Certified.

D. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.

1.3 REGULATORY REQUIREMENTS

A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Local Building Code
2. Local Electrical Code
3. NEC National Electrical Code

B. Other references:
1. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises...
2. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
3. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
4. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard
5. ANSI/TIA-568-C.4, Coaxial Cabling Component Standard
6. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical

Fibers (OM3/OM4). Current Edition
8. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.
9. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables
10. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable.
11. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard.
12. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Plant: OFSTP-7.
13. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A
14. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
15. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
16. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure
17. TIA/EIA-607-B - 2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications
18. Institute of Electrical and Electronic Engineers (IEEE 802.xLAN)
19. TIA/EIA 942 Data Center Standards
20. Current BICSI Telecommunications Distribution Methods Manual
21. NFPA 70 – National Electrical Code (NEC).
22. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes, regulations, and manufacturer installation requirements, then the requirements of these specifications and the drawings shall govern. However, nothing in the drawings or specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.4 ABBREVIATIONS

A. The following abbreviations are used in this document:

DC	Direct Current
IDF	Intermediate Distribution Frame
MDF	Main Distribution Frame
PBX	Private Branch Exchange
UTP	Unshielded Twisted Pair
SCS	Structured Cabling System
T.O.	Telecommunications Outlet

1.5 SUBMITTALS

A. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of Notice to Proceed:
1. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must have been granted on or before five years previous of proposal due date.
2. Products: Provide standard manufacturer’s cut sheets or other descriptive information.
3. Testing: UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
4. Provide a line-by-line item specification review indicating compliance or deviation

with full description of deviation.

5. Samples: Complete manufacturer's product literature and samples of patch panel, fiber terminations and station jacks with cover plate.

B. Documentation: Contractor shall provide documentation to include test results, and as-built drawings. An example of test results as they will be presented should be included with the shop drawings.

1. Fiber Test Results: hand written results are not acceptable. Copies of test results are not acceptable. Results to be provided on disk and printed form.
2. Work Station Cable Results: The results of the workstation cable tests shall be provided in the form of printouts from the test equipment.

C. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:

1. Complete manufacturer's product literature for all products installed during the course of the Project for Operation & Maintenance.
2. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to insure that the materials supplied and the work performed conforms to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
3. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
4. As-built Drawings shall include fiber and copper backbone cable routes, data outlet locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using Auto Cad 2014 electronic format or later on CD.

1.6 WARRANTY

A. Warranty:

1. The selected system installer shall be factory certified by the system component manufacturer, and shall provide an end-to-end performance warranty of not less than Twenty-five (25) years. The proposer shall provide certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that all cable links have been tested end-to-end using a Level 4 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568 and/or TSB-67 Link values.
2. The warranty shall also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B.
3. The warranty shall stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner / Architect / Engineer and designated representatives.

B. A Manufacturer's Extended Product Warranty and Application Assurance for this wiring system shall be provided as follows:

1. The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of TIA/EIA 568 and ISO/IEC IS 11801, exceed the attenuation and NEXT requirements of TIA/EIA TSB 67 and ISO/IEC IS

11801 for cabling links/channels, that the installation shall exceed the loss and bandwidth requirements of TIA/EIA TSB 67 and ISO/IEC IS 11801 for fiber links/channels. The warranty shall apply to all passive SCS components.

2. The Extended Product Warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).

C. The Warranty shall cover the failure of the wiring system to support the application which it was designed to support by recognized standards or user forums that use the ITA/EIA 568 or ISO/IEC IS 11801 component and link / channel specifications for cabling, for a twenty-five (25) year period.

D. Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company, registering the installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Structured Cabling Systems:
1. Leviton / Berk-Tek
2. Hubbell
3. Commscope Systimax
4. Commscope Uniprise
5. Belden
6. Mohawk

B. Support Systems:
1. Caddy
2. Panduit - Vertical & Horizontal Enhanced WMP Series
3. Leviton - Versi-Duct
4. Hubbell

C. Fiber Optic:
1. Commscope
2. Hubbell
3. Leviton/Berk-Tek
4. Belden
5. Mohawk

D. Racks and Metals:
1. Chatsworth
2. Hubbell
3. Cooper B-line

2.2 COLORS AND LENGTHS

A. Patch Panel Jack:
1. Data – Blue
2. VoIP – Green
3. Wireless Access Points – White
4. Security (Cameras and Intrusion) – Purple
5. Access Control - Yellow

6. POT – Gray

B. Telecommunications Outlet Jack:
1. Data – Blue
2. VoIP – Green
3. Wireless Access Points – White
4. Security (Cameras and Intrusion) – Purple
5. Access Control - Yellow
6. POT – Gray

C. Telecommunications Outlet Patch Cable (3-meter):
1. Data – Blue
2. VoIP – Green
3. Wireless Access Points – White
4. Security (Cameras and Intrusion) – Purple
5. Access Control - Yellow
6. POT – Gray

D. Patch Panel Patch Cable (1-meter):
1. Data – Green
2. VoIP – Blue
3. Wireless Access Points – White
4. Security (Cameras and Intrusion) – Purple
5. Access Control - Yellow
6. POT – Gray

E. Fiber Optic Cable:
1. Outer Jacket – Orange
2. Interlock Armor – Orange

2.3 GENERAL

A. Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications.

B. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
CM Communications Cable
CMP Plenum Rated Communications Cable
CMR Riser-Rated Communications Cable
OSP Outside Plant Cable

C. Initial Cable Inspection: 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 the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.

D. Cable Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.

2.4 DATA CLOSET (MDF/IDF) TERMINATION HARDWARE

A. Equipment Racks. Provide and install equipment racks in locations required and indicated on the attached Drawings. Racks shall be equipped as detailed and hereafter specified. Racks shall be 19” x 84” floor-mount. Provide enclosed patch panels in areas accessible by students and/or non-approved personnel.

B. Distribution Rack Grounding: Rack shall be grounded using stranded #6 AWG insulated copper conductor. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem and at building electrical service entrance.

C. Fiber Optic Patch Panels: The enclosures used shall provide termination panels for LC type connectors or as directed by Owner, and be of sufficient size and capacity to terminate the fiber count of the inside or outside fiber optic cables. Patch panels must be 19” rack mountable. Provide all termination accessories, enclosures and test for a complete fiber optic distribution system.

D. UTP Patch Panels shall consist of face plates pre-assembled with communication port housings and shall be 19” rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568 standards.
1. 48 port for Data/VoIP, angled configuration for enhanced cable management
2. 24 port for POT

E. Soft Cinch Velcro cable Management (IDF & MDF Rooms)
1. Velcro, lengths as required.
2. Blue color for data cables.

2.5 CABLE ROUTING/PATHWAY

A. Cable Tray - Ladder Racks: Metal cable tray shall be provided to affix to the top of all floor mount racks. Cable tray shall be used to brace racks to walls and to route cable from walls to racks in communications closets.

B. Cable Support System: Cable saddles, Bridle Rings shall be used to route all exposed cables (cable not in conduit or cable tray) in open access environments as well as in communications closets.
1. Flexible and non-metallic loop
2. Hold up to 5” diameter bundle of cable
3. Without sagging, bending or damaging cable

C. Cable Ties
1. Velcro, lengths as required.
2. Plenum rated ties in concealed locations.

D. Provide cable management panels as required for horizontal and vertical cable management at all racks.
1. Slotted duct configuration for copper and fiber cabling systems.

2.6 TELECOMMUNICATIONS OUTLET CABLE

A. The cable provided for all outlets shall be unshielded twisted pair, four-pair, solid copper conductor, meeting the intent and quality level of the TIA/EIA-568 Commercial Building

Wiring Standard. One (1) cable shall be installed for each port shown on the Drawings. Plenum rated CMP

2.7 TELECOMMUNICATIONS OUTLET HARDWARE

A. Flush mount jacks shall be high quality 8p 8c modular jacks with circuit board construction and IDC style or 110-style wire, T568 or T568B terminations (verify with Owner). Jacks shall meet EIA/TIA TSB40 recommendations for connecting hardware.
   1. Jacks shall be standard 8-position, RJ-45 Style, FCC compliant
   2. Jacks shall be designed for 4-pair, 100 Ohm balanced UTP Cable
   3. Jacks shall terminate 26-22 AWG solid or stranded conductors
   4. Jacks shall accept FCC compliant 6 position plugs.
   5. Jacks shall have attached wiring instruction labels to permit either T568A or T458B wiring configurations.
   6. Jacks shall be backward compatible with existing Category 3, 5 and 5E cabling systems for fit, form and function
   7. Jacks shall meet or exceed transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C2, Transmission Performance Specifications for 4-Pair 100 Ohm.
   8. Jacks shall be UL Listed and CSA certified.
   9. Each jack shall have category rating identified on the front face.
   10. Jacks shall include a dust cap for wire retention.

B. Face plates shall match building standard wiring device faceplates manufacturer at all locations. Refer to section 26 27 73 for wiring device faceplate specification. Verify color with Architect/Owner.
   1. Blank insert covers shall be provided for unused workstation ports.
   2. Submit samples for approval prior to purchase
   3. Provide necessary accessories for floor-mounted boxes
   4. Minimum four ports or as noted if greater
   5. 8-conductor Connector
   6. Wall mount phone faceplate, 8-conductor
   7. Faceplates shall be compatible with standard NEMA openings and boxes.
   8. Faceplates shall be UL Listed and CSA Certified.

C. Multimedia insert bulkhead shall be Decora style, color to match building standard wiring device color.

2.8 FIBER OPTIC PRODUCTS

A. Number of Fibers
   1. Multi-Mode Fiber between IDF & MDF.
      a. 12
      b. Distances greater than 500 meters, use OM4
   2. Single Mode Fiber between MDF & Outside Plant Locations.
      a. 12

B. OM1 Fiber Optic System:
   1. Each Multimode Fiber shall be:
      a. Graded-index optical fiber wave-guide with nominal 62.5/125µm-core/cladding diameter.
      b. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAA-

A.

c. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.
d. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.
e. The measurements shall be performed at 23°C ± 5°C.
f. Maximum attenuation dB/km @ 850/1300 nm: 3.5/1.0
g. OFL Bandwidth 200 MHz-km @ 850nm.
h. OFL Bandwidth 500 MHz-km @ 1300nm.
i. Optical Fiber shall guarantee 1Gigabit Ethernet distances of 300m/600m for 850nm and 1300nm respectively

2. Physical Characteristics:
a. Shall be suitable for use in indoors or in indoor/outdoor applications.
b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
c. Plenum rated optical cables shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating
d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
e. Suitable for underground or aboveground conduits.
f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
g. Shall have a ripcord for overall jacket.

C. OM2 Fiber Optic System:
1. Each Multimode Fiber shall be:
a. Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
b. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAB.
c. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.
d. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.
e. The measurements shall be performed at 23°C ± 5°C.
f. Maximum attenuation dB/km @ 850/1300 nm: 3.0/1.0
g. EMB Bandwidth 950 MHz-km @ 850nm.
h. OFL Bandwidth 500 MHz-km @ 1300nm.
i. Optical Fiber shall be Bend-insensitive and guarantee 1Gigabit Ethernet distances of 750m/600m for 850nm and 1300nm, respectively.
j. Optical fiber shall guarantee a 10 Gigabit Ethernet distance of 150m at 850nm

2. Physical Characteristics:
a. Shall be suitable for use in indoors or in indoor/outdoor applications.
b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
c. Plenum rated optical cables shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating.
d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
e. Suitable for underground or aboveground conduits.
f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
g. Shall have a ripcord for overall jacket.

D. OM3 Fiber Optic System:
   1. Each Multimode Fiber shall be:
      a. Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
      b. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAC.
      c. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.
      d. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.
      e. The measurements shall be performed at 23°C ± 5°C.
      f. Maximum attenuation dB/km @ 850/1300 nm: 3.0/1.0
      g. EMB Bandwidth 2000 MHz-km @ 850nm.
      h. OFL Bandwidth 500 MHz-km @ 1300nm.
      i. Optical Fiber shall be Bend-insensitive Laser Optimized and guarantee 1Gigabit Ethernet distances of 1000m/600m for 850nm and 1300nm, respectively.
      j. Optical fiber shall guarantee a 10 Gigabit Ethernet distance of 300m at 850nm
   2. Physical Characteristics:
      a. Shall be suitable for use in indoors or in indoor/outdoor applications.
      b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
      c. Plenum rated optical cables shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating
      d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
      e. Suitable for underground or aboveground conduits.
      f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
      g. Shall have a ripcord for overall jacket.

E. OM4 Fiber Optic System:
   1. Each Multimode Fiber shall be:
      a. Graded-index optical fiber wave-guide with nominal 50/125µm-core/cladding diameter.
      b. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAD.
      c. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.
      d. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.
      e. The measurements shall be performed at 23°C ± 5°C.
      f. Maximum attenuation dB/km @ 850/1300 nm: 3.0/1.0
      g. EMB Bandwidth 4700 MHz-km @ 850nm.
      h. OFL Bandwidth 500 MHz-km @ 1300nm.
      i. Optical Fiber shall be Bend-insensitive Laser Optimized and guarantee 1Gigabit Ethernet distances of 1040m/600m for 850nm and 1300nm, respectively.
      j. Optical fiber shall guarantee a 10 Gigabit Ethernet distance of 550m at 850nm
   2. Physical Characteristics:
      a. Shall be suitable for use in indoors or in indoor/outdoor applications.
      b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
      c. Plenum rated optical cables shall have and be marked with an UL-OFNP and

OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating

d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
e. Suitable for underground or aboveground conduits.
f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
g. Shall have a ripcord for overall jacket.

F. OM4+ Fiber Optic System:
1. Each Multimode Fiber shall be:
a. Graded-index optical fiber wave-guide with nominal 50/125μm-core/cladding diameter.
b. The fiber shall comply with the latest revision of ANSI/EIA/TIA-492AAAD.
c. Attenuation shall be measured in accordance with ANSI/EIA/TIA-455-78.
d. Information transmission capacity shall be measured in accordance with the latest revision of ANSI/EIA/TIA-455-204.
e. The measurements shall be performed at 23°C ± 5°C.
f. Maximum attenuation dB/km @ 850/1300 nm: 3.0/1.0
g. EMB Bandwidth 4900 MHz-km @ 850nm.
h. OFL Bandwidth 500 MHz-km @ 1300nm.
i. Optical Fiber shall be Bend-insensitive Laser Optimized and guarantee 1Gigabit Ethernet distances of 1210m/600m for 850nm and 1300nm, respectively.
j. Optical fiber shall guarantee a 10 Gigabit Ethernet distance of 600m at 850nm
2. Physical Characteristics:
a. Shall be suitable for use in indoors or in indoor/outdoor applications.
b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
c. Plenum rated optical cables shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating
d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
e. Suitable for underground or aboveground conduits.
f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
g. Shall have a ripcord for overall jacket.

G. OS2 Fiber Optic System:
1. Each Single-mode Fiber shall be:
a. Dispersion - unshifted single mode optical fibers with Low Water Peak complying with ITU-T G.652.D and with improved bending loss complying with ITU-T G.657.A1.
b. The zero dispersion wavelength shall be between 1300 nm and 1320 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.090 ps/km-nm^2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175-B.
c. The nominal mode field diameter shall be 9.2 μm with a tolerance of ± 0.4 μm at 1310 nm when measured in accordance with ANSI/EIA/TIA-455-191-B.
d. Transmission Characteristics:

e. Maximum cabled attenuation for loose tube fibers shall be 0.4/0.3 dB/km @ 1310/1550 nm.
f. Maximum cabled attenuation for tight buffer fibers shall be 0.7/0.7 dB/km @ 1310/1550 nm.
g. The cabled cutoff wavelength shall be ≤1260 nm when measured in accordance with ANSI/EIA/TIA-455-80-C.

2. Physical Characteristics:
a. Shall be suitable for use in indoors or in indoor/outdoor applications.
b. Appropriately flame rated optical cable shall be suitable for use in risers, plenums and horizontal applications.
c. Plenum rated optical cables shall have and be marked with an UL-OFNP and OFN FT6 Flame Rating. Riser rated optical cables shall have and be marked with an UL-OFNR and OFN FT4 Flame Rating
d. Shall comply with the requirements of ICEA S-83-596 (Premises), ICEA S-104-696 (I/O), or ANSI/ICEA S-87-640 (Outside Plant, OSP).
e. Suitable for underground or aboveground conduits.
f. Optical cables and fibers shall be color coded in accordance with EIA/TIA-598-C.
g. Shall have a ripcord for overall jacket.

H. Interlock armor fiber optic cables.
1. Steel or Aluminum
2. Riser-Rated or Plenum Rated
3. Outer and inner jacket
4. Colored Jacket

I. Fiber Optic Connectors shall be LC type connectors.
1. Coordinate connector type with Owner
2. Factory terminated

2.9 CABLING

A. All cabling used throughout this project shall comply with the requirements as outlined in the National Electric code (NEC) Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear CMP (Plenum Rated), CM/CMR (Riser Rated), OSP (Outside Plant Cable Rated) and/or appropriate markings for the environment in which they are installed. All fiber optic cabling shall be OFNP (Plenum Rated), OFNR (Riser Rated), OSP (Outside Plant Rated) and/or appropriate markings for the environment in which they are installed.

2.10 HDMI, VGA, SVGA, COMPOSITE VIDEO, RF VIDEO AND AUDIO HARDWARE

A. Acceptable Manufacturers:
1. Hubbell
2. Belden

B. Composite Video and audio cable shall be as specified for data cabling. VGA and SVGA cabling shall be Category 6 STP minimum, or shielded pre-fabricated, molded connector cable. HDMI shall be used specific cables for the bandwidth required.

C. Audio and composite video jacks shall be high quality RCA type modular jacks with circuit board construction and IDC style or 110 style wire terminations.

1. Faceplates shall match standard data communications system wiring device faceplates where possible. HDMI outlets shall consist of panel mounted HDMI shielded cables to stainless steel faceplate. Refer to Section 26 27 73 for wiring device faceplate specifications.
2. Blank insert covers shall be provided for unused workstation ports.
3. Submit samples for approval prior to construction
4. Provide necessary accessories for floor-mounted boxes.
5. Minimum six ports or as noted if greater.
6. RCA jack for composite video shall be white in color. Jack shall be gold plated with yellow stripe.
7. RCA jack(s) for audio shall be white in color. Jack shall be gold plated with red stripe (right audio), black stripe (left audio).
8. RF Video jack, F-type connector.
9. HDMI outlets with panel mounted cables.
10. HD15 cable shall be Belden #1279P mini high-res component video cable; HD15 connector, faceplates and inserts.

2.11 LABELS

A. Durable laser printable cable labels.
1. Designed to function in most desktop laser printers.
2. Durable Polyester label stock.
3. Self -Laminating wrap around design.
4. Available in US letter sheet size of 8.5" x 11".
5. Clear Polyester with White and Colored Print-on areas.
6. Polyester rated for 0F to 275F for indoor and outdoor applications.
7. Patch Panel Port Identification.
8. Face Plate and Port Labels.
9. 110 & NS6-110 Cross Connect Labels
10. Rack and Cabinet Labels.
11. Fiber Adapter Labels.
12. Pre-Printed Port Labeling.

PART 3 - EXECUTION

3.1 SYSTEM DESCRIPTION

A. The system shall utilize a network of fiber optic, and unshielded twisted pair, riser, tie and station cables. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings. Fiber cables shall terminate on Fiber Distribution Centers (FDCs) and/or modular patch panels located in all demarcation and termination points shown on the drawings or as required. All cables, and terminations, shall be identified at all locations. All cables shall terminate in an alphanumeric sequence at all termination locations. All copper cable terminations shall comply with, and be tested to TIA/EIA 568 and TSB-67 standards. Available and unused pairs between the ER and TC(s) shall terminate and shall be identified as spare at each location.

3.2 INSTALLATION

A. Furnish and install complete with all accessories a Structured Cabling System (SCS). The SCS shall serve as a vehicle for transport of data, video and telephony signals throughout the network from designated demarcation points to outlets located at various desk, workstation and other locations as indicated on the contract drawings and described herein. Applications

standards supported should include, but be not limited to, IEEE 802.3, 10Base5, 10BASE-T, IEEE 802.5, 4 Mbps, 16Mbps 328 ft. [100m], and TP-PMD. In addition, these links/channels shall be capable of supporting applications such as 100 Base-T and 52/155 Mbps ATM AND 77 Channel Analog Broadband Video to 550 Mhz. Gigabit cable performance shall be capable of supporting applications including AES/EBU Digital Audio, 270 Mbps Digital video, 622 Mbps 64-CAP ATM, 1000BASE-T Gigabit Ethernet and 1.2 Gigabit ATM.

B. The cabling shall be installed per requirements of the manufacturer and the Project Documents, utilizing material meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.

C. Cable Installation:
1. Cable shall not run in close proximity (6 inches perpendicular, 12 inches parallel) to power conduits (and other electrical noise sources). No patch panel, cable, outlet or punch block shall be within 6 feet of transformers or 12 inches of fluorescent lights, light fixtures, A/C wiring, radio systems or any other RF emitting device in ceilings or in/on walls.
2. Cable runs shall be free of splices, kinks, excessive slack, and damage to the outer jacket.
3. Cables shall be placed with sufficient bending radius so as not to kink, shear or damage the cable jacket or to otherwise diminish the transmission capability of the wire inside.
4. Cables shall be of a different color than those used by the non-IP, telephone, video cables or electrical cables in order to easily identify the data network wiring.
5. Cables shall not be painted.
6. Cable and/or cable bundles shall not be attached to any electrical wiring or light fixtures, nor will its vertical deflection allow it to come in contact with HVAC mechanical equipment, electrical wiring, conduits, piping, or fluorescent light fixtures.
7. All data cables shall be home runs from outlet at final termination to patch panel at IDF or home runs from outlet at final termination to MDF.
8. Cable shall run parallel and perpendicular to building lines. Changes in direction will be made with smooth bends, not exceeding minimum bend radius.

D. Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds.

E. Conduit sleeves shall be provided from outside IDF/MDF location to below ceiling area above ladder rack inside IDF/MDF. Minimum conduit size for data cabling sleeves shall be 4 inch.

F. Backboard: Provide an equipment backboard at each MDF, IDF, and telephone equipment location. Backboard shall be ¾" x 8' x 4' Grade A fire retardant plywood, with fire retardant paint. Coordinate placement of all equipment with Owner.

G. Any data cabling installed in any conduit that is run underground in or under building slab shall be outside plant rated and sealed at each end with approved gel cable/conduit sealant.

H. Cable Termination:
1. Number of twists per foot shall be maintained all the way to cable termination point.
2. Provide 1-meter service loop above ceiling for each drop.
3. Cable shall be terminated using tools specified by the cable manufacturer.

I. If there is no IDF or MDF within 90-meter cable limitations of drop, contractor shall be

responsible for additional IDF's as required for a complete system. Locate additional IDFs in Mechanical/ Electrical Rooms or as directed by Owner. Provide additional 120 volt power and receptacles as required for additional IDF locations, similar to those IDF's indicated or specified elsewhere.

J. Cable Pathway:
   1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 50 or less, station wiring with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported and attached to the building structure and framework at a maximum of five (5) foot intervals. The Contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all cables.
   2. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
   3. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.

K. Fire Wall Penetrations: the Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.

L. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.

M. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturer's allowable bend radius and pull tension data for the maximum allowable limits.

N. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.

O. Mounting heights shall conform to the Local Building Code Accessibility Standards. Mounting height shall match adjacent wiring devices unless noted otherwise.

P. Double duplex receptacle(s) shall be installed at all IDF locations and circuited to the nearest computer power panel board. Coordinate with Division 26.

Q. Contractor shall not hang cabling on pipes or wiring looms. Provide and install separate J-Hooks, cable saddles or cable trays to carry cable plant that is installed. Cable support shall be secured to building structure.

R. Conduit for cable shall be concealed inside walls for drops unless otherwise noted.

S. Emergency phone copper - PoT:
   1. All 25-pair "tie-cables" (between telephone company demarc and network racks) are to be terminated at a patch panel in the network rack.
   2. Tie-cables should be terminated using 1-pair at each port; the 25th pair should be doubled up on the last port (in a 24-port panel).
   3. Emergency phone locations.
      a. Locations as indicated.
      b. Elevator Machine
      c. Building Management Control Panel.
      d. Security System.
      e. Fire Alarm Panel

T. Cable Terminations above ceiling: Install each outlet above ceiling in an outlet box with terminal of same design as station hardware except with orange outlets. Terminations shall be facing the floor

U. Media interface: Provide outlets, connectors, cable, etc., as required for the intended function of audio / visual presentation.

V. Damage:
1. The Contractor shall replace or rework cable showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and excessive cable sheath has been removed.
2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation. Ceiling tiles shall match existing or new as specified elsewhere.

W. All clean-up activity related to work performed shall be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.3 VOICE ONLY (POT) PREMISE WIRE COMPONENTS

A. Closet Connections:
1. Provide (2) UTP tie-cables between MDF and each IDF.
2. Tie-cables shall be terminated using 1-pair at each port of POT patch panel. Provide additional patch panels in the MDF as required.
3. Tie-cables shall be home runs between the MDF and each IDF.
4. Each voice termination: Patch cables shall be pinned per TIA 568B and shall be terminated with 8p8c non-keyed slimline plugs with strain relief boots at the patch panel end. The other end shall be punched down to a wall mounted 66-block to accommodate the analog phone system. Provide (1) patch cord for each port used.

3.4 EQUIPMENT RACK CONFIGURATION

A. Equipment Racks:
1. Floor Mounted Equipment racks shall be assembled and mounted in IDF/MDF locations as required. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer’s instructions and recommendations. Racks shall be mounted such that the side rails are plumb. Racks and cable tray shall be grounded in accordance with NEC requirements. Rack shall be installed for future expansion and with proper access behind after electronic equipment is installed.
2. Wall Mount Cabinets shall be securely mounted to vertical surfaces in accordance with the manufacturer’s instructions and recommendations. Cabinets shall be mounted such that the cabinet sides are plumb. The cabinet top shall be mounted 7 feet from the finished floor. Cabinets shall be grounded in accordance with NEC requirements.
3. Provide at least 60% of mounting space remaining after patch panel's installation for later placement of hubs/routers etc. in each rack.
    a. Provide vertical patching of data cables, instead of horizontal patching; this requires that each network rack be populated with no more than 40% of patch panels, leaving 60% of the available rack space for customer equipment
    b. Coordinate with Owner and allow space between each patch panel for switches. Population of rack shall be from top to bottom.
4. Provide additional racks, 3 total, for Owner provided equipment in each MDF

location.

5. Provide coordination drawing with IDF/MDF equipment layout for approval prior to installation.

B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks.

C. Cable Placement: Cable installation in the wiring closet 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 location. 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 a working distance from these openings.

D. Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

E. All incoming cables shall be routed on the ladder rack and neatly dressed down to the patch panels.

F. Provide rack and jack panel hardware as required for all data station wiring.

G. All patch panels shall be provided with 25% spare capacity for future growth.

H. A Power Strip shall be installed vertically at the back of each data rack. Verify with Owner.

3.5 TELECOMMUNICATIONS OUTLET WIRING INSTALLATION

A. General:

1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connections points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed UTP cable at either the wiring closet or the workstation termination locations.

B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable shall only be run where indicated on the Drawings. Additional exposed cable runs shall require Owner approval, and shall only be allowed when no other options exist. Cabling shall be installed concealed at all times, except in unfinished mechanical rooms or wiring closets where cable shall be installed exposed and located to avoid conflicts with pass-through cabling, etc. Tie wraps shall be used to provide a neat appearance. Provide Velcro straps to dress the cable.

C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner’s efficient use of their full capacity.

D. Cable Minimum Bend Radius and Maximum Pulling Tension:
   1. Do not exceed bend radius for UTP = 4 X Cable OD, FTP = 4 X Cable OD.
   2. Install unshielded twisted-pair cables so that there are no bends smaller than 4 times cable outside diameter at any point in the run and at the termination field.
   3. Pulling Tension on 4-Pair UTP Cables: Do not exceed 25 ft.lb. for 4-pair UTP cable.

E. Pair Untwist at Termination: Do not exceed 12 mm (1/2 inch).

F. Bend Radius of Horizontal Cables:
   1. Not less than 4 times OD of UTP cables.
   2. Not less than 4 times OD of FTP cables.

G. Maintain cable jacket to within 25 mm (1 inch) of termination point.

H. Neatly bundle cables and dress to their respective panels or blocks.
   1. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame.

I. Cable Routes:
   1. All cabling placed in ceiling areas must be in conduit, cable tray or J-Hooks. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section. Backbone and horizontal cabling shall be routed in separate supports.
   2. Use approved cable support devices for all locations, eg: (J-Hooks with appropriate connection devices). Contractor shall use the Manufacturers recommendation for sizing J-Hook for all Category 6 cabling:
   3. All J-Hooks shall be installed on 48” maximum centers at irregular intervals. Communications cable shall be rerouted so as to provide a minimum of 12 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. If 12 inch separation is not possible Contractor shall provide shielding between cable bundle and EMI source. Cabling supports shall not be attached to conduit, unistrut, piping, ducts, ceiling grid support wires or any other equipment or hangers for other trades. Cable runs shall be parallel or perpendicular to building structure. Multiple cables are to be bundled together every 5 feet.
   4. The installation of j-hooks shall be at irregular intervals to prevent harmonic disturbance. Maximum separation of j-hooks shall be 48” on center. The distance between each j-hook shall be inconsistent throughout the project.

3.6 TELECOMMUNICATIONS OUTLET PATCH CABLE

A. Provide (1) patch cable for each telecommunications outlet. Cable shall be tested as part of the SCS. Leave cable installed in station jack, neatly coiled and tie wrapped.

B. Provide VGA, HDMI, composite video, and left and right channel audio station cables for the video and audio wiring devices indicated or required at each initiation and receiving station (one patch cable for each wiring device outlet).
   1. Station cables shall be highly flexible factory molded cable assemblies. Contacts shall be gold plated. Cable outer jacket shall be black.
   2. For each pair of station cables, provide one 2-meter (receiving station) and one 3-

meter station cable (initiation station).

3. Station cables shall be left connected in the jack, coiled, dressed and tie-wrapped as directed by the Owner/Architect.
4. Provide patch cord as required.

3.7 PATCH PANEL PATCH CABLES

A. Each patch panel: Patch cables shall be pinned per TIA 568B or Standards (Verify with Owner / Architect) and shall be terminated with 8p8c non-keyed slimline plugs at both ends. Provide strain relief boots.

B. Patch cables shall be managed and dressed at patch panel to insure neat appearance.

C. Provide 10-percent spare patch cables of each.

3.8 TELECOMMUNICATIONS OUTLET HARDWARE

A. Flush mount jacks shall be mounted in a faceplate with back box.

B. Placement: Where possible, the communications outlet shall be located so that its centerline is 18” above floor level or 12” above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches. Verify exact location with architectural elevation drawings, millwork and furnishings.

C. 8p 8c Jack Pin Assignments:
1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B unless directed otherwise by Owner / Architect.
2. Pin connections at data jack patch panels shall match pin connections at outlets (straight through wiring).

3.9 FIBER OPTIC CABLE INSTALLATION

A. Provide fiber between MDF and IDFs.

B. Place fiber optic cables to maintain minimum cable bend radius limits specified by manufacturer or 15 times cable diameter, whichever is larger.

C. Between MDF and IDF(s) provide fiber cable using inner duct or armored cable encasing all fiber cable; label inner duct every ten feet.

D. Fiber optic cable rated underground shall be installed in conduit. Conduit shall contain three inner ducts or provide multi-cell conduit unless specified otherwise.

E. Cable terminations shall be performed by manufacturer trained and certified technicians. Terminations shall be made in a controlled environment. The Contractor may choose to have the cables assembled off-site, although testing must be completed with the cable in its final installed condition.

F. Warning Tags: At each location where fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning: “CAUTION FIBER OPTIC CABLE”. The text shall be permanent, black, block characters, and at least 3/16” high. A warning tag shall be permanently affixed to each

exposed cable or bundle of cables, at intervals of not less than five (5) feet. Any section of exposed cable that is less than five (5) feet in length shall have at least one warning tag affixed to it.

G. Fiber paths shall be separate from copper paths.

3.10 CABLE TESTING

A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.

D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

E. Twisted Pair Cable Testing
1. At a minimum, the Contractor shall test all station drop cable pairs from data closet termination patch panel port to station insert. Products shall be tested for compliance to ANSI/TIA/EIA 568 and ISO/IEC 11801 for a rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level 4 accuracy. Further, the Contractor shall have a copy of TSB-67 in their possession and be familiar with its contents. Testing shall be against either appropriate category standards or the manufacturer's specifications whichever is more stringent and applicable.
2. Each wire/pair shall be tested at both ends for the following:
    a. Wire map (pin to pin connectivity)
    b. Insertion loss (dB)
    c. Attenuation
    d. Near end cross talk (NEXT)
    e. ELFEXT (dB)
    f. Structural Return Loss
    g. Delay Skew (ns)
    h. PSNEXT (dB)
    i. ACR
    j. PSACR
    k. Equal Level Far End Crosstalk (ELFEXT)
    l. PSELFEXT (dB)
    m. Far End Crosstalk (FEXT)
    n. Propagation Delay (ns)
3. Test Category 6A by auto test to 500 MHz.
4. Test Category 6 by auto test to 250 MHz.
5. Test Category 5e by auto test to 100 MHz.
6. Test equipment shall provide an electronic and printed record of these tests. Test equipment calibration documentation shall be available for on-site inspection.

7. Test results of each four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and 8p8c jacks and must match as-builts associated with that cable.

F. Fiber Optic Cable Testing
1. Testing procedures shall be in accordance with the following:
   a. ANSI/TIA-568-C.3
   b. ANSI/TIA-526-7, Method B
   c. Proposed TSB-140 Tier One Fiber Certification, C
   d. Encircled Flux testing per the TSB-4979 and TIA-526-14-BDtandard.
2. Testing device for OSP fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test trace and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as ST or SC connector terminations.
3. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
4. After installation, the Contractor shall test each intra-building fiber strand with a power meter for multimode, 1310 nm and 1550 nm wavelengths for Singlemode, end-to-end insertion loss, at both 850 and 1300 nm. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end to end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
5. Acceptable fiber optic cable and connector loss shall not exceed 1.5 dB. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.

G. Acceptance of the Data Communications Cabling System shall be based on the results of testing, functionality, and the receipt of documentation. With regard to testing, all fiber segments and all workstation data cables must meet the criteria specified. With regard to functionality, the contractor must demonstrate to the Owner that 100 Base-T data signals can be successfully transmitted, bi-directionally, from the MDF and from some number of individual data outlets. The number of outlet locations to be tested shall be determined by the Owner.

3.11 ADDITIONAL REQUIREMENTS

A. Provide data outlet to central plant area; coordinate final location with Building Management Control System.

B. Provide data cable to the following locations. Coordinate final location.
1. Main Fire Alarm Panel.
2. Intrusion Alarm Panel.
3. CCTV Digital Video Recorder.
4. Elevator Machine Room Panel
5. Access Control Panel
6. School Communication System
7. Building Management and Control System

C. Provide data wiring from each cash register (POS System – Point of Sale) to nearest IDF or MDF location. Provide wire and wiring methods approved by the Owner.

D. Provide data cable from master employee time clock to slave time clock as directed by Owner.

3.12 INSPECTION

A. Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

3.13 STRUCTURED CABLING SYSTEM IDENTIFICATION

A. Coordinate with Architect and Owner's Information Systems Department the required SCS identification prior to construction. Exact nomenclature for identification shall be submitted in writing to the Architect for review prior to final identification.

B. Cable Drop Label Nomenclature:
   1. Each port shall be identified using the following convention:
   2. IDF# - Floor# (only if IDF serves multiple floors) - Blade# - Port# (Example: IDF101-B1-P1)
   3. Each port on the “front” or facing side of each patch panel shall be identified using the following convention:
      a. Room # (Graphic #); Label for wireless jack shall be of contrasting color
   4. Each patch panel or “blade” shall be identified on the “front” or facing side using the following convention:
      a. MDF#-Blade# (Example: MDF# - B1)
      b. IDF#-Blade# (Example: IDF# - B1)
   5. In each rack, blade numbering should begin with blade #1 occupying the upper left patch panel (as viewed from the “front” of the patch panels), extending down vertically through each rack’s complement of patch panels, and sequencing to the upper patch panel in the next adjacent rack.
   6. All data cable jackets should be labeled at both terminations:
      a. Cable end at faceplate termination should be labeled to match faceplate designation.
      b. Cable end at IDF/patch panel termination should be labeled to match back port designation on patch panel.

E. Label fiber on each IDF and MDF patch panel. Label in a manner that designates clearly which IDF they are originating from and where they are going - i.e. From IDF#__ to Room #___ or to MDF Room # ___.

3.14 DOCUMENTATION

A. All as-built documentation and test results are to be approved and stamped by a Registered Communications Distribution Designer (RCDD). Provide Auto Cad 2014 as built drawings and electronic format test results.

B. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding data outlets. The font shall be at least one-eighth inch (1/8”) in height, block. All labels shall correspond to as-builts and to final test reports.

C. Contractor shall ensure complete durable laser printable cable labels typed labeling of all outlets and cables with numbers that correspond to locations on the punch down block. Labeling system shall correspond to the Owner’s labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.

D. Final system room designations shall be based on actual room number graphics. (Do not use Architectural drawing room designations).

E. All cables shall be labeled at both ends and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.

F. A floor plan, clearly labeled with all outlet jack numbers, shall be included in the as-built plans. Install additional copy of floor plan in each IDF & MDF.

G. Provide owner with total count of ports used per IDF / MDF location.

END OF SECTION

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

NOTE – THIS SECTION APPLIES TO ELECTRICAL SHEETS E001 THROUGH E009

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cabling identification products.
4. Grounding provisions for twisted pair cable.
5. Source quality control requirements for twisted pair cable.

1.2 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. LAN: Local area network.

E. Jack: Also commonly called an "outlet," it is the fixed, female connector.

F. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

G. RCDD: Registered Communications Distribution Designer.

H. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

I. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

J. STP: Shielded twisted pair.

K. UTP: Unscreened (unshielded) twisted pair.

1.3 COPPER HORIZONTAL CABLING DESCRIPTION

A. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. Cabling administration Drawings and printouts.
2. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

a. Telecommunications pathways.
b. Typical telecommunications details.

C. Twisted pair cable testing plan.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 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. Plugs: Ten of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated:

a. Type CMP complying with UL 1685.

2. Communications, Non-Plenum Rated:

a. Type CMR complying with UL 1666.
b. Type CMP or Type CMR in listed plenum or riser communications raceway.
c. Type CMP or Type CMR in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E84; testing 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.

C. RoHS compliant.

2.4 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100-ohm, 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP) or Shielded twisted pairs (STP) as indicated.

E. Jacket: Blue thermoplastic.

2.5 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of cable specified..
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

D. Connecting Blocks:

1. 110-style IDC for Category 6.

E. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA-568-C.1.

C. Factory test twisted pair cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Routing:

1. Install cables in raceways and cable trays, except within cabinets and other accessible equipment. Conceal raceway and cables, except in unfinished spaces.

    a. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

B. Comply with Section 270528 "Pathways for Communications Systems."

E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable

between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.

10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Group connecting hardware for cables into separate logical fields.

D. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

3.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install inelectrical cabinet. List outgoing cables and their designations and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

D. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

C. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Collect, assemble, and submit test and inspection reports.

END OF SECTION 271513

SECTION 280100 - OPERATION & MAINTENANCE MANUALS OF ELECTRONIC SAFETY & SECURITY SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Compile Electronic Safety and Security (ESS) product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare ESS operating and maintenance data as specified in this Section and as referenced in other sections of specifications.

B. Instruct Owner's personnel in operation and maintenance of equipment and systems.

C. Submit three (3) electronic copies, on separate devices (CD, USB Flash Drive, or some type of solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer’s operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.

D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.

E. Recorded video of all training sessions shall be included in each copy, of each system’s final submitted O&M.

F. The final submitted manual shall include a sing-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant’s stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System’s O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:

1. Table of Contents for each element
2. Contractor information
3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant’s stamp of acceptance.
4. All parts and maintenance manuals for items of equipment
5. Warranties (without starting dates)
6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
7. Operating and maintenance procedures.
8. Form of Owner's Training Program Syllabus (including times and dates)
9. Control operations / equipment wiring diagrams
10. Coordination Drawings
11. Schedule of Low Voltage Wire and Cable
12. Schedule of ESS Equipment
13. Schedule of ESS Field Devices
14. Access Control Door Schedules
15. Video Surveillance Camera Schedules

16. Other required operating and maintenance information that are complete.
17. Cable pathway layout drawings and station map, including through wall and floor penetration locations and sleeve sizes.

B. Copy will be returned to the Contractor within 15 days with comments for corrections.

C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.

D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.

E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.

F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
2. Minimum ring size: 1"; Maximum ring size: 3".
3. When multiple binders are used, correlate the data into related groupings.
4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

A. Form for Manuals Submitted in Hard Copy Format:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
2. Format:
   a. Size: 8-1/2" x 11"
   b. Text: Manufacturer's printed data or neatly typewritten.
3. Drawings:
   a. Provide reinforced punched binder tab and bind in text.
   b. Fold larger drawings to size of text pages.
4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
   a. Title of Project
   b. Identity of separate structures as applicable
   c. Identity of general subject matter covered in the manual.

6. Binder as specified

B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
   a. Contractor, name of responsible principal, address and telephone number
   b. A list of each product required to be included, indexed to content of the volume.
   c. List with each product, name, address and telephone number of:
      1) Subcontractor or installer
      2) Maintenance contractor as appropriate
      3) Identify area of responsibility of each.
      4) Local source of supply for parts and replacement
   d. Identify each product-by-product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
   a. Include those sheets pertinent to the specific product.
   b. Annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
3. Drawings:
   a. Supplement product data with drawings as necessary to illustrate:
      1) Relations of component parts of equipment and systems
      2) Control and flow diagrams
   b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
4. Written text as required to supplement product data for the particular installation:
   a. Organize in consistent format under separate headings for different procedures.
   b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued
   a. Provide information sheet for Owner's personnel, giving:
      1) Proper procedures in event of failure
      2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.

C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
   a. Description of unit and component parts:
      1) Function, normal operating characteristics, and limiting conditions.
      2) Performance curves, engineering data and tests.
      3) Complete nomenclature and commercial number of replaceable parts.
   b. Operating procedures:
      1) Start up, break-in, routine / normal operating instructions
      2) Regulation, control, stopping, shut down and emergency instructions
      3) Special operating instructions
   c. Maintenance procedures:
      1) Routine operations
      2) Guide to trouble-shooting
      3) Disassembly, repair and reassembly
      4) Alignment, adjusting and checking
      5) Routine service based on operating hours
   d. Manufacturer's printed operating and maintenance instructions.

e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
   1) Items recommended to be stocked as spare parts.
f. Schedule of low voltage wire and cable
g. Schedule of ESS equipment
h. Schedule of ESS field devices
i. Each Contractor's coordination drawings.
   1) As installed color coded wiring and cabling diagrams.
j. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
k. Other data as required under pertinent sections of the specifications.

2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
4. Provide complete information for products specified in Division 27.
5. Provide certificates of compliance as specified in each related section.
6. Provide start up reports as specified in each related section.
7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.

END OF SECTION

SECTION 280500 - ELECTRONIC SAFETY AND SECURITY BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 28 Electronic Safety and Security.

B. Applicable provisions of this section apply to all sections of Division 28, Electronic Safety and Security.

C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
1. Division 26 in its entirety.
2. Division 27 in its entirety.
3. Division 28 in its entirety.

D. The entire drawing and specification package apply to the work specified in the Electronic Safety and Security specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.2 CODES AND STANDARDS

A. All equipment and work performed shall comply with all of the current and applicable Codes, Rules, Ordinances, Regulations and Standards (including those not specifically listed in this Specification) as interpreted and enforced by the authorities having jurisdiction including:
1. Americans with Disabilities Act (ADA)
2. Authorities Having Jurisdiction (AHJ) - Local
3. American National Standards Institute (ANSI)
4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
5. Building Industry Consulting Services International (BICSI)
6. Code of Federal Regulations - Title 47
7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
11. International Electro-technical Commission (IEC)
12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*

14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
16. National Electrical Contractor's Association (NECA) *Standards of Installation*
17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
18. National Electrical Safety Code (NESC)
19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
20. Society of Cable Telecommunications Engineers (SCTE)
21. Local Accessibility Standards
22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
23. Uniform Building Code (UBC)
24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*

B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.

C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.

D. Obtain all permits required.

1.3 SUMMARY

A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.

B. It is the intent of the Contract Documents to provide a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.

C. Provide complete and working ESS Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The ESS Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All ESS Systems plans and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR’S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:
1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
3. Perform work by persons qualified to produce workmanship of specified quality.

Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:

a. Licenses, as applicable to the system being installed
b. Manufacturer's Certifications
    1) Firm Certification
    2) Installer Certification
    3) Programmer's Certification
    4) System Designer Certification.

1.5 DRAWINGS AND SPECIFICATIONS

A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Consultant for review. No departures shall be made without prior written acceptance of the Consultant.

C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Consultant in writing, shall be performed or furnished. In the case that the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large-scale details govern small scale drawings.

D. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.

H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.

I. The Contractor shall be responsible for coordination and proper relation of his work to the

building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the project's consultant of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.

J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 BUILDING CONSTRUCTION AND LAYOUT OF WORK

A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes, ordinances, and standards; as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.

C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Consultant. The Consultant reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.

D. In areas of existing special ceiling construction, the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.

B. Because of the complicated relationship of this work to the total project, conscientiously study

the relation and cooperate as necessary to accomplish the full intent of the documents.

C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3” beyond the finished surface. In pipe chases, they shall extend 8” inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio.1/2 inch greater than outside diameter of the conduit.

D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.

E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.

1. Make final connections to all ESS equipment indicated on the drawings, except as noted.

F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment

performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

A. Manufacturers names and catalog number specified under sections of Division 28 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.

C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work:
   1. Obtained from utility maps and other substantially reliable sources.
   2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.

B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 CONTRACT DRAWINGS

A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

Abbreviations:

A/V	Audio/Visual
AWG	American Wire Gauge
BCR	Building Communications Room
CMP	Communications Media Plenum
CMR	Communications Media Riser
dB	Decibel
EMI	Electromagnetic Interference
ER	Equipment Room
ESS	Electronic Safety and Security

FACP	Fire Alarm Control Panel
FCR	Floor Communications Room
Hz	Hertz
IDF	Intermediate Distribution Frame
Km	Kilometer
LCD	Liquid Crystal Display
LED	Light Emitting Diode
M	Micron
MDF	Main Distribution Frame
MHz	Megahertz
NEXT	Near-End Cross Talk
nm	Nano-meter
OFN	Optical Fiber Non-conductive
OFNP	Optical Fiber Non-conductive Plenum
OFNR	Optical Fiber Non-conductive Riser
OTDR	Optical Time Domain Reflectometer
TC	Telecommunications Closet *(Now referred to as TR)*
TR	Telecommunications Room *(A.K.A. TC - Telecommunication Closet)*
UTP	Unshielded Twisted Pair Wire

Definitions:

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the ESS Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the ESS Systems operational or for system communications.

Electronic Safety and Security Systems - One or more of the following and associated equipment: Fire Detection/Alarm Systems, Intrusion Detection/Alarm Systems, Access Control Systems, Video Surveillance Systems,

1.16 QUALITY ASSURANCE

A. Equipment Standards:
   1. System and all components shall be brand new stock from manufacturer.
   2. All electronics shall be 100% solid state.
   3. System and all components shall bear a UL Label.

B. Contractor Qualifications:
   At the time of Proposal, the Contractor shall:
   1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
   2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
   3. Hold all legally required state registrations to meet local requirements for submittal drawings.
   4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be

fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.

5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

A. Provide SUBMITTALS according to Division 1 and the following.

B. Requirements:

1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
2. Submit proof that all system components and cables are U.L. Listed.
3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
4. Product technical information sheets for each principal components in the proposed system, including cable, wire, terminal marking, and wire marking material.
5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.

B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

A. The Contractor is responsible for complying with all of the Owner's and facility security's

requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.

B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and underslab cables installed, dimensioning exact location and elevation of such installations.

B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014+ / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one

set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.

1. 3 sets of electronic AutoCAD (2014+ dwg) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
3. Three sets of blue or black-line prints of each contract as-built drawing.

C. As-Built Drawings should indicate the following information as a minimum:

1. Indicate all addendum changes to documents.
2. Remove Engineer's Seal, name, address, and logo from drawings.
3. Mark documents AS-BUILT DRAWINGS.
4. Clearly indicate: DOCUMENT PRODUCED BY:
5. Indicate all changes to construction during construction. Indicate actual routing of all conduit and cables, etc that were deviated from construction drawings.
6. Indicate exact location of all underground ESS raceways, and elevations.
7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
9. Exact location of all ESS equipment in building. Label panel schedules to indicate actual location.
10. Exact location of all ESS equipment in and outside of the building.
11. Location, size and routing of all ESS cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
13. Cloud all changes.

1.26 OPERATING TESTS

A. After all ESS systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.27 WARRANTY

A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.

B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

A. General: Refer to Division 01 for general requirements on temporary facilities.

B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.

C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.28 EXTRA MATERIALS

A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.3 STANDARD PRODUCTS

A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.4 MANUFACTURE’S INSTRUCTIONS

A. The Contractor is responsible for furnishing the proper Electronic Safety and Security equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Consultant.

2.5 RUST PREVENTION

A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.6 STORAGE AT SITE

A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.

C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

A. All materials required for the installation of the Electronic Safety and Security systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surfaces: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.

B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.

C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.

D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.

E. If appropriate, interfaces with the Owner's Data Network or Telecommunications System shall be coordinated with the Owner and Architect.

F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.

G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.

H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.

I. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire

system. Units shall be installed parallel and square to building lines.

J. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.

K. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation if applicable, the more stringent shall apply.

L. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.

M. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.

N. The installation shall be performed in a professional manner.

O. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.

P. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.

Q. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.

R. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.

B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.

B. All wires in exposed areas shall run through conduit as specified in Division 26.

C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.

D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.

E. Run wires continuously from termination to termination without splices.

F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at not rime shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.

G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2” or larger sized conduits.

H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.

I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). ESS cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.

J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.

B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all ESS Systems wiring.

C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the

name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.

D. Identification of Equipment:
   1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
   2. A black-white-black 3-layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and ESS cabinet or rack.
      a. Identifying nameplates shall have 1/2-inch high, engraved letters.
   3. Permanent, waterproof, black markers shall be used to identify each ESS grid junction box, clearly indicating the type of system available at that junction box.
   4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.

E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.

F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of ESS facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.

G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.

H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried ESS lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the ESS systems.

1. Provide the training during regular working day.
2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.

C. Time to be allocated for instructions.
1. Minimum of 12 hours dedicated instructor time
2. 4 hours on each of 3 days
3. Additional instruction time for specific systems as specified in other Sections.

D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
1. One copy to the Owner
2. One copy to the Architect / Engineer

D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.

E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.

G. Demonstrate equipment functions (both individually and as part of the total integrated system).

H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.

J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
1. Before any cutting or trenching operations are begun, verify with Owner's

representative, utility companies, municipalities, and other interested parties that all available information has been provided.

2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.

B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each ESS location.

3.13 SITE MANAGEMENT RESPONSIBILITY

A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR’S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.

B. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Consultant. Where items scheduled for relocation and/or reuse are

considered unsuitable for reuse, the Contractor shall so notify the Consultant and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at no additional cost to the Owner or the Consultant.

C. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work ad in accordance with standard practice of the trades involved.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Consultant.

3.15 EXISTING SYSTEM TESTING

A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current Master Format7 Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.

B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.

C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.

D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all ESS Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect’s judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer’s factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.

B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.

C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
   1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
   2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.

B. All materials shall be neat, clean and unmarred, and parts securely attached.

C. All extra material as specified shall be delivered and stored at the premises as directed.

D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.

B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
   1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
   2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
   3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that cam in the original shipping container for that piece of equipment. Include all warranty cards.

C. Testing:
   1. The Contractor shall perform all tests required by Division 28 and those submitted as part of this Section.
   2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
   3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.

D. As-Built Drawings:
   1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
   2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.

E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
   1. System Operations and Maintenance Manuals
   2. System Test Reports
   3. As-Built Drawings

3.19 NOTICE OF COMPLETION

A. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

SECTION 280507 - SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Prepare submittals as required by Division 1 and as outlined below.

B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.

C. The term submittal, as used herein, refers to all:
1. Shop Drawings
2. Coordination Drawings
3. Product data

D. Submittals shall be prepared and produced for:
1. Distribution as specified
2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.

B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.

C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".

B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

C. For each room containing ESS equipment and each rack with ESS equipment, submit plan and elevation drawings. Show:
1. Actual ESS equipment and components to be furnished.
2. NEC working space and NEC access to NEC working space.
3. Relationship to other equipment and components and openings, doors and obstructions
4. Rack location and dimensions

D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

E. Verify location of ESS station devices and other work specified in this Division.
   1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
   2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.

F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.

B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.

C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.

D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer/Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

A. Review submittals prior to transmittal.

B. Determine and verify:
   1. Field measurements
   2. Field construction criteria
   3. Manufacturer's catalog numbers
   4. Conformance with requirements of Contract Documents

C. Coordinate submittals with requirements of the work and of the Contract Documents.

D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.

E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.

G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.

H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
1. Proper sizes and capacities
2. That the item will fit in the available space in a manner that will allow proper service
3. Construction methods, materials and finishes

I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.

B. Number of submittals required:
1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.

C. Accompany submittals with transmittal letter, in duplicate, containing:
1. Date
2. Project title and number
3. Contractor's name, address and telephone number
4. The number of each Shop Drawing, Project Datum and Sample submitted
5. Other pertinent data

D. Submittals shall include:
1. The date of submission
2. The project title and number
3. Contract Identification
4. The names of:
    a. Contractor
    b. Subcontractor
    c. Supplier
    d. Manufacturer
5. Identification of the product
6. Field dimensions, clearly identified as such
7. Relation to adjacent or critical features of the work or materials
8. Applicable standards, such as ASTM or federal specifications numbers
9. Identification of deviations from contract documents
10. Suitable blank space for General Contractor and Architect / Engineer stamps

11. Contractor's signed and dated Stamp of Approval

E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

A. Every submittal document shall bear the following information as used in the project manual:
1. The related specification section number
2. The exact specification section title

B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

A. Make resubmittals under procedures specified for initial submittals.
1. Indicate that the document or sample is a resubmittal
2. Identify changes made since previous submittals

B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.

D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

A. The Architect / Engineer will:
1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal

3. Return submittals to Contractor for distribution or for resubmission

B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

A. Do not make requests for substitution employing the procedures of this Section.

B. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

A. Submittals shall not be combined or bound together with any other material submittal.

B. Submit individually bound shop drawings and product data for the following when specified or provided:
1. Low Voltage Wire
2. Electronic Access Control and Intrusion Detection
3. Electronic Surveillance
4. Fire Detection and Alarm

3.2 COORDINATION DRAWINGS

A. Submit coordination drawings as specified.

END OF SECTION

SECTION 280510 - CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.

D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence.

B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

A. When required in individual Specification Sections, manufacturer shall provide a manufacturer’s qualified personnel to observe:
   1. Field conditions.
   2. Condition of installation.
   3. Quality of workmanship.
   4. Start-up of equipment.
   5. Testing and adjusting of equipment.

B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

1.7 MOCK UPS

A. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.

B. Do not proceed with any work involving a mock-up, until the related mock up has been approved in writing.

C. Acceptable mock-ups in place shall be retained in the completed work where possible.

D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
   1. Rough-in
   2. Finish with all appurtenances in place
   3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

A. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

SECTION 281000 - ACCESS CONTROL SYSTEM (ACS)

PART 1 - GENERAL

1.1 RELATED WORK

A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
   1. Conditions of the Contract
   2. Division 1
   3. Division 26
   4. Division 27
   5. Division 28

1.2 WORK INCLUDED

A. Reference Attachment ‘A’ of this specification for supplemental scope and product material list as it relates to the project and the Owner standards.

B. The Contractor shall furnish and install a complete microprocessor-based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.

C. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.

D. The system shall include security for all access into building, including but not limited to the following:
   1. Control Panels
   2. Power Supplies.
   3. Interconnection of panels.
   4. Installation of new devices.
   5. Card reader.
   6. Magnetic locking hardware
   7. Request to exit devices
   8. Door position sensors
   9. Door Hardware (as specified herein and/or in Division 08, door hardware)
   10. Servers
   11. Clients
   12. Mobile application
   13. Badging Station; including Enrollment Readers, Cameras, Software, and Printers
   14. Lockdown and Lockout Buttons
   15. Audio Intercom Systems
   16. Licensing
   18. All additional material, hardware, and labor required for a fully functional, turnkey system

E. The contractor shall connect each controller to the ACS Management System.

F. All system programming will be performed by the system installer. The system installer will be required to meet with the Owner, engineer, and system manager to discuss wiring and termination of the system control panels and field devices prior to installation.

G. Licensing: The contractor shall NOT utilize any of the owner's existing licensing for this scope of work. All licensing shall be provided by the contractor, no exceptions. Including, but not limited to the following:
1. Portal Licensing
2. Controller Licensing
3. Wireless Licensing
4. Video Management Software Integration Licensing

H. Contractor to refer to specification 08 71 00 Door Hardware. Provide and install all hardware specified to be provided by the "Access Control Contractor", "Security Installer", "Division 28", or any variation thereof.

I. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 REFERENCES

A. Code of Federal Regulations (CFR).

B. Institute of Electrical and Electronics Engineers (IEEE):
1. 802.3 Ethernet Standards.
2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.

C. International Electrotechnical Commission (IEC).

D. International Organization for Standardization (ISO):
1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).

E. Federal Communications Commission (FCC):
1. FCC Part 15 – Radio Frequency Device

F. Underwriters Laboratories (UL):
1. UL294 – Access Control Systems Units

G. Electronic Industries Alliance (EIA)

1. RS485 - Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems

H. Federal Information Processing Standards (FIPS)
1. Advanced Encryption Standard (AES) (FIPS197)
2. FIPS201-2: Open Options DNA Fusion FIPS in conjunction with an E2-SSP-D2-FIPS, NSC-100-FIPS, RSC-2-FIPS and other listed components will provide an access control solution that is fully FIPS 201-2 compliant.
3. Personal Identity Verification (PIV) of Federal Employees and Contractors

I. Homeland Security Presidential Directive 12 (HSPD12)

J. National Fire Protection Association Standards:
1. NFPA 70 - National Electrical Code
2. NFPA 72 - National Fire Alarm Code
3. NFPA 101 - Life Safety Code

K. RoHS compliant

L. SIA AC-01-1996.10 - Access Control - Wiegand

M. Local & State Building Codes

N. Requirements of Local Authorities having Jurisdiction

O. Requirements of American Disabilities Act (Public law 101-336).

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:
1. The installing contractor shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least two years.
2. The installing contractor shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
3. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
5. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.
6. The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
7. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
8. For proper, smooth, and complete integration of the IP security camera, access

control, and intrusion detection systems; the proposing/installing contractor of the video surveillance and intrusion detection systems must be the same contractors.

9. Contractor must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 75-miles of the project, and be able to include information on current support staff to be able to service this client.

1.5 SUBMITTALS AND CLOSE-OUT

A. Product Data: Within fourteen (14) days of Notice to Proceed, the system installer shall furnish the following in a single consolidated submittal:

1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
2. Product Literature: Complete manufacturer's product literature for all system equipment, power supplies, cable, termination components, cable supports, cable labels, field devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation, demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be submitted.
3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been accepted by the project's technology consultant.
5. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
    a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
    b. Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
    c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system

B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:

1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
2. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
    a. Location of all control equipment and remote power sources

b. Locations of all field devices and outlets
c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
e. Location of sleeved wall and/or floor pass-thru
f. Size of sleeve at each location installed
g. Quantity of cable passing through each sleeve
h. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.

3. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the project's technology consultant.

C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:

1. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
6. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the system from the original approved shop drawings.
7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
8. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
9. A copy of the manufacturer's warranty on the installed system.
10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
11. Operating and Maintenance Instructions for all devices within the system. These

instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)

12. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Provide a video copy of the training session as well as all sign in and training sign off sheets
13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. Contractor shall provide one complete floor plan sheet at each panel location.

1.6 DEFINITIONS

A. Abbreviations:

1.	ACS	Access Control System
2.	VMS	Video Management System
3.	NVR	Network Video Recorder
4.	IDS	Intrusion Detection System
5.	GUI	Graphical User Interface
6.	IP	Internet Protocol
7.	CR	Card Reader
8.	DS	Door Station
9.	MS	Master Station
10.	PIR	Passive Infrared Sensor
11.	LD	Lockdown
13.	LO	Lockout
14.	MDF	Main Distribution Frame
15.	IDF	Intermediate Distribution Frame

B. Definitions:

1. Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enabled applications on mobile devices.
2. Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secured areas.
3. Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through and the times they are permitted.
4. Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
6. Alarm: A signal that indicates a problem.
7. Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
8. Badge: Badge is a template or a design for creating a card. DNA Fusion includes a full-featured badge layout utility for designing, creating, and printing badges. Badge design includes magnetic stripe encoding, bar coding, signatures, and so on.
9. Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.

10. Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
11. Card and Card Holder: A card is an identity proof of a person and a card holder is a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
12. Controller: A microprocessor-based circuit board that manages access to a secured area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
13. Card Reader: A device that retrieves information stored on an access card and transmits that information to a controller.
14. Digital Video Recorder: A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
15. Door: A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.
17. Duress: Forcing a person to provide access to a secure area against that person's wishes.
18. Input: An electronic sensor on a controller that detects a change of state in a device outside the controller.
19. Integrated lockset: An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
20. Keypad: An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer keyboard.
21. Output Relay: A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or deactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
22. Shunt Time: The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
23. Time Schedules: Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
24. Video Management System: An enterprise-class video management and storage solution

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.9 PROJECT CONDITIONS

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

1.10 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

A. The ACS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.

B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 - PRODUCTS

2.1 Reference Attachment ‘A’ of this specification for supplemental scope and product material list as it relates to the project and the Owner standards

2.2 MANUFACTURERS

A. Approved Manufacturers:
1. Genetec, Inc.
2. Lenel
3. Monitor Cast
4. Open Options
5. RS2 Technologies
6. S2

B. Requests for substitutions will be considered in accordance with provisions of Division 1. In the absence of direction by Division 1, substitution request must be submitted no less than ten (1) business days from the time of proposal.

2.3 SERVERS AND USER INTERFACE

A. The ACSMS shall consist of three components: Database Server, Application Server, and User Interface. These components shall run on a single computer, virtual or physical, or on multiple computers allowing scalability in the configured architecture.
1. Database Server
a. Microsoft SQL Express/Enterprise 2008 R2 or higher
b. Processor (Intel Core i7 or equivalent) or greater
c. 4 GB RAM or greater
d. 100 HDD or greater
e. 10/100 NIC or greater
f. Windows 7 Enterprise, Windows 8/8.1 Enterprise, Windows 10 Enterprise, Windows Server 2008 R2, Windows Server 2012 (*Operating systems must be Professional/Enterprise versions and not Home/Personal editions.)
2. Application Server
a. Windows 7 Enterprise SP1 or higher
b. Windows 10 Enterprise or higher

c. Windows Server 2008 R2 or higher recommended
d. Processor (Intel Core i7 or equivalent) or greater
e. 4 GB RAM or greater
f. 100 GB HDD or greater
g. 10/100 NIC or greater
h. Windows 7 Enterprise, Windows 8/8.1 Enterprise, Windows 10 Enterprise, Windows Server 2008 R2, Windows Server 2012 (*Operating systems must be Professional/Enterprise versions and not Home/Personal editions.)

3. User Interface
   a. Windows 7 Enterprise SP1 or higher
   b. Windows 10 Enterprise or higher
   c. Windows Server 2008 R2 or higher recommended
   d. Processor (Intel Core i7 or equivalent) or greater
   e. 4 GB RAM or greater
   f. 100 GB HDD or greater
   g. 10/100 NIC or greater
   h. Windows 7 Enterprise, Windows 8/8.1 Enterprise, Windows 10 Enterprise, Windows Server 2008 R2, Windows Server 2012 (*Operating systems must be Professional/Enterprise versions and not Home/Personal editions.)
   i. The requirements listed above shall be considered minimum requirements. Should the requirements of the specified manufacturer exceed these requirements, the contractor shall provide in compliance with the manufacturer.
4. Application Services and Driver Components
   a. DVR/NVR integration driver
   b. Alarm panel driver
   c. Axis driver
   d. Flex API
   e. Camera events driver
   f. Thyssen-krupp driver
   g. Kone driver
   h. SMTP mailer
   i. Scheduled export
   j. Time and attendance module
   k. Time tracking module
   l. Mustering module
   m. Badge Designer
   n. Photo ID module
5. Mobile and Web Browser
   a. Apple and Windows based Web browser
   b. Mobile for iOS and Android
6. Access Control Software Interfaces
   a. System shall consist of a data exchange tool used for provisioning personnel/cardholder information and access level assignment within the ACS by creating a logical link to the authoritative data source. The authoritative data source shall be one or more ActiveX Data Objects (ADO) compliant connections. Some examples of ADO compliant connections are Microsoft Active Directory, PeopleSoft, SQL Server database, CSV file, etc.
   b. The system shall consist of an Interface to be used for the integration of 3rd party systems in order to expand the overall ACS. These systems can include, but are not limited to, visitor management systems, video managements systems, identity management systems, intrusion detection systems, and physical security integration modules (PSIM).

2.4 ACCESS CONTROL SYSTEM (ACS)

A. General: The ACS is a modular and networked based system providing physical access control security to a Wide Area campus enterprise. The system shall be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACS is to be alterable at any time depending on the facility requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote workstations. The ACS shall include, but is not be limited to, the following:

1. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking environment.
    a. The ACS to permit multiple instances of client software applications to run simultaneously on the network. The base system shall include one (1) software application licenses per site with an unlimited number of licenses available subject to connection fees.
2. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.
    a. Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.
3. Encryption: The system to support encrypted communication between the central server software and client software applications (sever-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).
    a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
    b. The ACS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.
4. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.
    a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.
5. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and command functions.
6. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.

7. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of cardholders into the database, and import / export of employee data.
8. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
9. Alarm Monitoring: The system is able to monitor, report, and provide information about the time and location of alarms, along with their priority.
10. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
11. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
12. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide
13. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors overriding scheduled access control restrictions and configurations if necessary.
14. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
15. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
16. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via local area network/wide area network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum of concurrent users/clients with software expansions to an unlimited number of workstations based on the Owners network requirements.

B. Open Architecture: The access control system infrastructure will be based on an open architecture design capable of supporting multiple access control hardware manufacturers and integrate with multiple non-proprietary network processors, controllers, interface modules, integrated locking hardware, remote card readers, keypads and display terminals, and other third party applications.

C. Open Protocol: The ACS manufacturer to provide non-proprietary, open protocol hardware for the system control processors and associated device sub-controllers. Systems utilizing a single manufacturer solution that encompasses combined proprietary software and integrated electronic hardware combinations are not acceptable. In addition, integrated electronic locking hardware requiring a processor or sub-controller module upgrade, or extensive access control firmware upgrades to accommodate integrating with an alternate software package, will not be considered.

D. Network Support: Communication network connecting the central server host software modules, client workstation software applications, and hardware controllers to be designed to support all of the following:
1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.
2. Direct-connected RS-232 and RS-485 communication cabling.

3. Dial-up modem connection using a standard dial-up telephone line.

E. Provide local communication port at each panel for local configuration of system with laptop.

F. Locate all main control panels in MDF and IDF rooms of each building.

G. Provide 120v at all controller and power supply locations.

H. Provide and transfer all required licensing to the owner.

I. Provide local communication port at each panel for local configuration of system with laptop.

J. Integrated Wireless/Intelligent Locks: The ACS shall support the following wireless/PoE/WiFi/intelligent locksets
1. Allegion
   a. RS485 - AD300
   b. Wireless - AD400
2. Assa Abloy
   a. WiFi - IN120
   b. PoE - IN220
   c. Aperio – AH30

K. Integrated Video Management Systems: The ACS shall support integration of DVR and/or NVRs from the following manufacturer.:
1. ExacQvision
2. Milestone
3. OnSSi
4. Salient Systems
5. Video Insight

2.5 ACCESS CONTROL PANEL HARDWARE

A. Enclosure:
1. Typical 4-Door System Enclosure:
   a. Power supply board 75W, 6A/12V or 3A/24V | Secondary voltage power supply, 5-18V adjustable @ 4A max, class 2 power limited output | Eight output smart distribution module, fused at 3A per output | Four port network monitoring module | Enclosure, Size with backplate to accommodate the specified hardware.
2. Typical 8-Door System Enclosure:
   a. Power supply board 150W, 12A/12V or 6A/24V | Secondary voltage power supply, 5-18V adjustable @ 4A max, class 2 power limited output | 16 auxiliary DC outputs class 2 power limited at 2.5A per output | Eight output smart distribution module, fused at 3A per output | Four port network monitoring module | Enclosure, (23W x 32H x 6.5D) with backplate to support the mounting of the specified hardware.
3. Power supplies shall be connected to the Owner’s network, allowing for remote management, including but not limited to the following:
   a. Allow the user to connect any network connected power within a local network or via the internet from any remote location.
   b. Allow for all connected power supplies to be monitored for status and firmware revision on a single screen.
   c. Allow batch firmware updates to maintain the latest feature sets and

cybersecurity standards.

B. System Control Processor: Intelligent two portal two reader combination system controller with 10/100Base-T Ethernet connectivity and dual reader interface module, minimum of 6MB RAM, 1 RS-232/485 host port, with a secondary RS-232/485 host port for redundancy, 1 two wire RS-485 channel for communication to a maximum of 31 I/O modules, support for up to two magstripe or Wiegand readers. Includes a minimum of two (2) door contacts, two (2) request to exit inputs, two (2) door strike relays, four (4) programmable inputs and two (2) output relays

C. Door Controllers: Two Portal Two Reader interface module - support for up to two magstripe or Wiegand readers. Includes: two door contacts, two requests to exit inputs, two door strike relays, four programmable inputs and four output relays

D. Input Monitor Modules: 16 normally open or closed, supervised or non-supervised inputs for monitoring vital alarm points or for providing elevator floor selection control. Includes: 2 programmable output relays and (32) 1K ohm resisters for supervisory wiring

E. Output Control Modules: 16 programmable output relays with the option of being configured as fail-safe or fail-secure. These relays support "On", "Off" or "Pulse" modes for a variety of applications such as elevator control or any device requiring dry contacts.

F. System Back-Up Battery: Contractor to backup batteries as required to furnish ninety (90) minutes of run time to the complete system, including but not limited to lock power and system power.

G. RS-485 Communications Multiplexer: Provide a multiplexer at each control board that is utilizing a RS-485 communication channel to panel interface modules and/or RS-485 type door hardware. There shall be no more than eight (8) RS-485 connections made on a single multiplexer.

2.6 FIELD DEVICES

A. General: Coordinate with door hardware and access control schedule as to whether each access control portal is wireless or directly connected to a control panel. Provide all Controllers, Sub-Controllers, and licensing as required to connect all card reader locations shown on plan.

B. Card Readers: Provide card readers as shown on the floor plans, access control schedule, and access control details.

C. Credentials: Coordinate Facility Code, External Start Number, and Internal Start number with the Owner prior to procuring credentials.

D. Miscellaneous Devices: Provide the following devices as designated per the project floor plans, access control schedules, and access control details:
1. DP/DT Door Position Sensors (Door Contacts)
2. PIR Motion Request to Exit Sensor
3. Lockdown Buttons
4. Door Release Buttons
5. Video Intercom Door Stations
6. Video Intercom Master Stations

2.7 WIRING

A. Ethernet cabling shall be provided by the Structured Cabling System Installer. In the event that there is not ACS installer on the project, cabling shall be provided and installed by the Access Control System Integrator and shall comply with the Division 27 Structured Cabling specification.

B. Conventional access control cable shall be a jacketed composite cable. The minimum conductor requirement shall be as follows:
   1. Standard
      a. Lock Power: 4-conductor, 18AWG, shielded
      b. Card Reader: 6-conductor, 22AWG, OA shielded
      c. Door Contact: 2-conductor, 22AWG, shielded
      d. Request to Exit/Spare: 4-conductor, 22AWG, shielded
   2. Extended Distance
      a. Lock Power: 4-conductor, 16AWG, shielded
      b. Card Reader: 6-conductor, 18AWG, OA shielded
      c. Door Contact: 2-conductor, 18AWG, shielded
      d. Request to Exit/Spare: 4-conductor, 18AWG, shielded

C. Wire scheme and conductor quantity shall be as required by the manufacture's specifications. Contractor to provide and install shielded cable as required.

D. All 120v Power shall be furnished by the Division 26 contractor. In the event that a division 26 contractor is not contracted for the project, the system installing contractor shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.

E. All Security Conduit as required for a complete installation of this system shall be furnished by the division 26 contractor as part of their scope of work. In the event that a division 26 contractor is not contracted for the project, the system installing contractor shall provide and install all conduit required.

F. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.

G. All systems shall be connected to a dedicated circuit and on an emergency power source if available.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so, approved by the local authority having jurisdiction.

C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.

D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.

F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.

H. Network Connection Cable: Provide a 4 pair Category 6 data cable from the Master Control Panel to the MDF network rack. Category 6 cable shall be purple in color.

I. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.

J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer’s recommendations.

3.2 CABLE PATHWAYS

A. Cable Support:
1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
   a. Approved Cable Support Product:
      1) Panduit
      2) Arlington
      3) Caddy
      4) Support system shall be sized appropriately for the number of wires being installed. Reference the manufacturer’s specifications for the suggested maximum cables per support size.
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5’ of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5’ of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
3. J-MOD™ cable support shall be installed at a maximum of 5’ on center.
4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building’s steel or supported in any other method than that stated above.
6. It is the responsibility of the installing contractor to coordinate with all other trades

on the project to ensure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.

B. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.

3.3 SYSTEM ZONING AND PARTITIONING

A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.

3.4 TESTING

A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner and the project’s Technology Consultant and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.

B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.5 WARRANTY

A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.6 SOFTWARE

A. Provide two electronic copies of the final programming and program software to the Owner’s Security Supervisor after final approval.

END OF SECTION

SECTION 281500 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide and install a fully functional intrusion detection system which shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings and all other accessories required to provide a complete and operable system.

B. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system as specified. The Contractor shall provide all security system devices required for complete corridor perimeter coverage acceptable to all governing authorities.

C. The system shall include intrusion for all egress corridors in the building.
1. The Control System shall be the product of a single manufacturer.
2. Tag all conductors or cables at each end.
3. Installation of security panels.
4. Interconnection of security panels.
5. Installation of new security devices.
6. Full coverage of all egress corridors.
7. Preconstruction meeting with Owner’s personnel, installing technician and project superintendent.

D. The system shall be wired as a Class B system for all circuits.

1.2 CODES AND STANDARDS:

The system shall comply with the applicable Codes and Standards as follows:

A. Governing Authorities:
1. UL864 – Control Units System (L, CS, -A, M, SS, WF)
2. UL1610 – Central Station Burglar Alarm Units
3. UL609 – Local Burglar Alarm Units
4. UL365 – Police Station Burglar Alarm Units

B. Local & State Building Codes.

C. Requirements of Local Authorities having Jurisdiction.

D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.

E. Requirements of American Disabilities Act (Public law 101-336).

F. Local Accessibility Standards.

G. State Insurance Code.

1.3 QUALITY ASSURANCE

A. Contractor Qualifications:
   1. The installing contractor shall be the authorized representative of the Security Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the security alarm manufacturer's product for at least five years.
   2. The installing contractor shall be licensed by the State as a security services contractor to design, sell, install, and service security alarm systems.
   3. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
   4. The installing contractor shall have been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least five (5) years.

1.4 SUBMITTALS

A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
   1. Complete point-to-point wiring diagrams.
   2. Riser diagrams.
   3. Complete floor plan drawings locating all system devices.
   4. Factory data sheets on each piece of equipment proposed.
   5. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
   6. Complete system bill of material.
   7. Line by line specification review stating compliance or deviation.

B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. DMP

2.2 BURGLAR ALARM SYSTEM

A. Main Panel
   1. Shall provide up to 58-Zones
   2. Shall have on-board ethernet communication
   3. Shall be DMP XT50

B. System Keypads
   1. Shall be two-line alphanumeric
   2. Shall be DMP 7073N

C. Siren
   1. Shall be Bosch LH1-10M10E or approved equal
   2. Provide necessary amplification equipment, tie to DMP board

D. Enclosure
   1. Shall be tan
   2. Shall have tamper switch
   3. Shall have lock and key

E. Motion Detectors
   1. Shall detect passive infrared and microwave
   2. Shall have 360-degree coverage
   3. Shall be Bosch DS9370

F. Duress Buttons
   1. Shall be wireless
   2. Shall be a dual contact button
   3. Shall be supervised for low battery, and send warnings

G. Door Contacts
   1. Shall be triple biased
   2. Double Pole/Double Throw

H. Door Chime
   1. Shall tie to the door contact
   2. Final location to be coordinated with owner

I. Silent Strobe
   1. Ceiling Mounted Blue
   2. Shall tie to the silent duress alarm, via DMP

J. Power Supply
   1. Shall have integral 12V lead-acid batteries
   2. Shall be DMP

K. False Alarm Prevention: The system shall include the following false alarm prevention features: audible exit delay, arm/disarm bell squawk, audible exit fault, urgency on entry delay, no entry arming/disarming. Swinger shutdown programmable by zone, transmission delay by zone, AC fail, TLM trouble and low battery trouble transmission delay, recent close code transmission, police code (cross zone) transmission, opening after alarm transmission, and arming/disarming from outside the protected space using access control.

L. Central Station Reporting: The system shall provide high speed 20 bps 1400/2300 Hz. handshake, contact ID and SIA reporting formats and shall be capable of being programmed to call up to 3 telephone numbers. The system shall also allow communication to a pager. The telephone numbers shall be programmable for “backup” dialing should the primary number fail. The system shall be programmable for split reporting such that alarms/restorals, openings/closing and miscellaneous events can be sent to different telephone numbers. The

system shall report a separate account code for each partition and for non-partition (system) events.

1. The system shall provide opening/closing scheduled suppression to prevent opens and closes from being reported to the central station. The system shall be capable of reporting all alarms, trouble, and system status information by combinations of all communication methods installed including: digital communicator, a cellular transmitter, and DVAC.

M. System Printer: The system shall be capable of including a serial output for a hard copy printer installed anywhere on the Combus. All system events, alarms and restorals shall be printed and each event shall include the partition, date and time.

N. System Event Buffer: The system shall have a 3,000-event buffer. All events shall be printable from the system printer. The 2,800 most recent events shall be viewable by keypad LCD display. All events shall be viewable by upload/download PC.

O. Power Supply/Relay Output Modules: The systems shall be capable of including up to 64 fully programmable output relays with form ‘C’ contacts rated 2Amps at 30VDC. Relays shall be added in modules of four and may be located anywhere on the Combus. Each module shall include a supervised 350mA 12VDC battery charger, and integral power supply to supply up to 1.0Amp of auxiliary power at 12VDC to power direct connected devices or re-power the Combus.

P. Low Power Outputs: The system shall be capable of including up to 144 low power outputs with each output able to supply 50mA at 12VDC. Outputs shall be added in increments of 16 and may be added anywhere on the Combus.

Q. Remote Annunciation: The system shall be capable of remote zone alarm and system status annunciation, up to 144 points, by adding 32- and 64-point annunciators anywhere on the Combus. Annunciators shall be capable of being flush mounted. The annunciators shall provide bulls eye and graphic annunciation capability.

R. System Software: The base panel shall come complete with all the software to implement every system feature and allow the addition of every expansion or functional module without changes or addition to the basic software.

S. System Programming:

1. The system shall be fully programmable via the LCD keypads and shall also allow event buffer viewing via the keypads.
2. Separate PC based upload/download software shall allow programming and operation from a directly connected local computer, or from a remote computer via a telephone line or LINKS cellular communications equipment. Remote access shall be controlled by the Owner to prevent unauthorized access.
3. All system programming shall be maintained in non-volatile memory such that program information is maintained even if all AC and battery power is removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.

C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.

D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

E. Minimum conduit size shall be ¾-inch EMT. Install conduit per engineered shop drawings.

F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, at all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.

H. Telephone Cable: Provide a 4 pair Category 6 telephone cable from the Master Control Panel to the Telephone Equipment Room.

I. Each motion sensor shall be an addressable zone.

J. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring in D-rings or J-hooks. Support D-rings or J-Hooks. Cable shall be bundled on a maximum of 2-foot-6-inches. D-rings or J-hooks shall be secured to the structure at a maximum of 5-foot on center. Bundling shall be with plenum rated cable ties. Cable shall not be directly attached to building structure.

3.2 SYSTEM OPERATION

A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:
   1. The system keypad’s interior audible device shall sound until silenced by using proper security code or after system time out.
   2. A custom system alarm message shall be displayed on the LCD display. This display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.
   3. The remote signaling tie connection shall be activated at the Owner’s approved central security monitoring location and/or other Owner designated location.

3.3 SYSTEM ZONING AND PARTITIONING

A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.

B. All zoning/device locations shall be field programmable.

C. Input control zones shall be as indicated on the drawings.

D. The zoning shall at a minimum partition in the following ways, coordinate all requirements with owner prior to final programming:

3.4 COMMISSIONING THE SYSTEM

A. The installing contractor shall be responsible for verifying that each component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.

B. A state licensed and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.

C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Any items found not properly installed or non-functioning shall be replaced or repaired and retested.

D. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed burglar alarm superintendent responsible for supervising the final system test and checkout.

E. The installing contractor's burglar alarm superintendent shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections, as may be required by the local authorities. The Contractor shall affix his certification label and installation certificate to the interior of the main burglar alarm control panel.

F. The testing and acceptance shall be performed within 30 days after the burglar alarm installation is completed. The test shall be performed by a minimum of two qualified burglar alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all burglar alarm system equipment shall include the following:

1. Burglar alarm control equipment: a visual and functional test of the burglar alarm control and auxiliary control equipment.
2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.

4. Indicators shall be tested to ensure proper function and operation.
5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.
7. Burglar alarm peripheral devices; All burglar alarm peripheral devices shall be functionally tested, and the location and testing information recorded for each device.
8. Manual initiating devices:
    a. Each manual alarm station at each keypad shall be functionally tested for alarm operation.
    b. Each manual alarm station at each keypad shall be functionally tested for proper wiring supervision.
9. Automatic initiating devices:
    a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
    b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
    c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
10. Alarm signaling devices:
    a. Each alarm signaling device shall be tested and decibel reading taken at 10-feet from the device and recorded to ensure proper operation.
    b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
    c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
    d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
11. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all burglar alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100 percent audit shall be performed by a factory trained representative.

G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance be provided by the Owner. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.

3.5 EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a permanently engraved or embossed or silk screen identification tag. The tag shall include the following information:
1. Name of manufacturer.
2. Manufacturer's equipment description.
3. Serial number and model number.
4. Voltage and current rating.

3.6 SPARE PARTS AND TOOLS

A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage in a Contractor provided cabinet located in the building where directed by the Owner. Provide a wall mounted cabinet; factory finished, keyed like the burglar alarm control panel, and located in the emergency control center or as directed by Owner, Architect.

B. Spare Parts:
   1. Six spare fuses of each size used in the system
   2. Six spare detectors of each type in the system
   3. Spare system keys (6) of each
   4. Two copies of the final software programmed into the burglar alarm system.
   5. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner’s cabinet.

C. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

3.7 KEYS

A. Keys and locks for all equipment shall be identical. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

3.8 GRAPHIC FLOOR PLANS

A. Provide color coded floor plan detailed with room names, graphic room numbers and adequate information to direct people to the burglar alarm devices in alarm with Non-fading floor plan media.

B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All burglar alarm devices located to correspond with the annunciator.

C. The floor plan shall be solvent welded in acrylic plastic.
   1. Mount in an extruded aluminum frame next to the main burglar alarm control panel.

D. Post minimum 11x17 size drawing, color laminated As-Built of system identifying all devices, key pads, panels and partitions on the wall near main control panel.

3.9 ADDITIONAL REQUIREMENTS

A. The contractor is to ensure all areas of the egress corridors are covered with motion detectors.

B. Provide all accessories required for off-site monitoring. Coordinate with Owner for appropriate off-site monitoring service.

C. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (5) motion detection devices for future expansion. The initial design shall not exceed 70% of the rated power supply and circuit capability.

D. Provide surface mount door contacts on all outside odors and roof hatch. Do not wire intrusion detection devices inside door frames.

E. Do not place guard covers over motion detectors except in harsh environment such as gyms.

F. Alarm systems must have a dedicated 120 VAC circuit on an emergency power panel.

G. Intrusion detection shall be one system for entire building, armed and disarmed from any keypad in the building.

H. The inside hallways shall have motion detectors where indicated or required to eliminate any dead zones.

3.10 SUBSTANTIAL COMPLETION

A. Final acceptance of the Burglar Alarm System by the Owner, local code authorities and Occupancy Permit has been issued.

3.11 WARRANTY

A. The new components and installation of the expanded burglar alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of substantial completion. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification.

B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.

C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.

D. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

E. Provide a certified burglar alarm test of the complete system at the end of the warranty period and correct any and all items to bring the system to an approved status at no cost to the Owner.

F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of "As-Built" drawings and schematics of all equipment.

3.13 TRAINING

A. Provide training course to all security personnel assigned by Owner's Representative. The training shall include a course syllabus and hands-on participation. Training shall be conducted on a system identical to the one being installed on this project. The system shall be able to perform all system operations and simulate all types or forms of alarm conditions.

B. Provide a video of the training program to the Owner's Representative to be used for periodic refresher course, training of the local security department and for training of new employees.

C. The training course shall include, in addition to the above, a system overview, and a review of the operation and maintenance manual.

D. The instructor shall be factory trained and shall be thoroughly familiar with all parts of the installation on which instruction is to be given. The instructor shall be trained in operating theory as well as in practical operation and maintenance work.

3.15 SOFTWARE

A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

SECTION 282000 - VIDEO SURVEILLANCE SYSTEM (VSS)

PART 1 – GENERAL

1.1 RELATED WORK

A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
   1. Conditions of the Contract
   2. Division 1
   3. Division 26
   4. Division 27
   5. Division 28

1.2 GENERAL PRODUCT REQUIREMENTS

A. The software used shall be designed for enterprise level use, with an expected use period of 24/7. It shall be the Manufacturer's official software.

B. The software shall incorporate open standards and published protocols and use standardized components.

C. The Video Management System provider shall be defined as the provider of the video management software, and the party responsible for rigorous self-testing of the video management software prior to the release of the software.

1.3 GENERAL SYSTEM DESCRIPTION

A. The Video Management System shall support both centralized and decentralized configurations as well as hybrid options for architecture. Centralized management shall be available no matter the surveillance architecture. The system shall allow for integration with other security devices and products and be designed to allow for levering of those products to improve the user experience of the VMS.

B. The VMS shall not require a central management server.

C. The VMS shall make the user experience seamless to the end user irrespective of the system architecture.

D. The VMS must be capable of each server being able to handle an unlimited number of cameras for recording.

E. The VMS must support Windows Server 2008, 2012, and Windows Server 2016 for the server side. Client- side software must be available for Windows 7, 8 and 10, Mac OSX, iOS 6 and above, and Android. The operating system shall have all current and available patches.

F. The VMS shall include the following without additional license fees:
   1. Client software for Windows.
   2. Client software for Mac OSX.
   3. Client software for iOS 6 and above.

4. Client software for Android-based platforms.
5. Client software using a web-based interface.
6. Standalone clients designed to provide fixed displays.
7. Video Wall functionality.
8. SmartSearch.
9. Access Control Integration.
10. Full Access Control software platform.
11. Failover server functionality.
12. A separate health monitor application.

G. The VMS shall not require a separate application for administration and user-based roles. Limitations for non-administrative users shall be handled via permissions.

H. The system shall support running in Virtual Servers for both the server application and client applications

1.4 SECTION INCLUDES

A. Video Management Systems:
1. Server application.
2. Desktop application.
3. Mobile application.

B. Servers:
1. Rackmount.
a. Servers will be provided, installed, and programmed by the system installer.
b. Server sizes and quantities shall be based on the needs to meet the requirements established by, but not limited to the following:
1) Bandwidth
2) Camera resolution
3) Client workstation access
4) Frame rates
5) Video Compression
6) Motion based recording
7) Maximum of sixty-four (64) views per server
8) Days of Retention
c. Provide a minimum of one server per site

C. IP security cameras.

D. VMS software licenses.

E. Encoders and decoders.

F. Controller systems.

G. Accessory products.

1.5 REFERENCES

A. Code of Federal Regulations (CFR).

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 802.3 Ethernet Standards.

C. International Electrotechnical Commission (IEC).

D. International Organization for Standardization (ISO):
   1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
   2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
   3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).

E. Federal Communications Commission (FCC):
   1. FCC Rules and Regulation of Title 47 of CFR Part 15 Subpart B Class A.

F. Open Network Video Interface Forum (ONVIF):
   1. ONVIF - Profiles S Specification.

G. Underwriters Laboratories (UL):
   1. UL listed.

1.6 DEFINITIONS

A. Abbreviations:
   1. ARP - Address Resolution Protocol.
   2. DHCP - Dynamic Host Configuration Protocol.
   3. DNR - Digital Noise Reduction.
   4. DDNS - Dynamic Domain Name Server.
   5. FPS - Frames Per Second.
   6. GUI - Graphical User Interface.
   7. HDD - Hard Disk Drive.
   8. HTTP - Hypertext Transfer Protocol.
   9. ICMP - Internet Control Message Protocol.
   10. IGMP - Internet Group Management Protocol
   11. IP - Internet Protocol.
   12. iSCSI - Internet Small Computer System Interface.
   13. JBOD - Just a Bunch of Disks.
   14. JPEG - Joint Photographic Experts Group.
   15. MJPEG - Motion JPEG.
   16. MP - Megapixel.
   17. MPEG - Moving Pictures Experts Group.
   18. NAS - Network Attached Storage.
   19. NTP - Network Time Protocol.
   20. POS - Point of Sale.
   21. PPPoE - Pont to Point Protocol over Ethernet.
   22. RAID - Redundant Array of Independent Disks (Drives).
   23. RTP - Real-Time Transport Protocol.
   24. RTCP - Real-Time Control Protocol.
   25. RTSP - Real-Time Streaming Protocol.
   26. SMTP - Simple Mail Transfer Protocol.

27. SNMP - Simple Network Management Protocol.
28. SSL - Secure Sockets Layer.
29. TCP - Transmission Control Protocol.
30. UDP - User Datagram Protocol.
31. UPnP - Universal Plug and Play.
32. VMS - Video Management System.
33. PoS - Point of Sales.
34. VA - Video Analytics.
35. PnP - Plug and Play.
36. ARB - Auto Recovery Backup.
37. NVR - Network Video Recorder.
38. RAID - Redundant Array of Independent Disks.

B. Definitions:
1. JBOD: A collection of hard disks that have not been configured to act as a redundant array of independent disks (RAID) array.
2. GOV (Group of Video object planes): A set of video frames for H.264 and H.265 compression, indicating a collection of frames from the initial I-Frame (key frame) to the next I-Frame. GOV consists of 2 kinds of frames: I-Frame and P-Frame.
3. Dynamic GOV: Dynamic assignment of GOV length based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
4. Dynamic fps: Dynamic assignment of frames per second based on the complexity of the scene to efficiently manage bitrate of the video stream and reduce the storage required.
5. ARB (Auto Recovery Backup): Automatic backup mechanism that enables cameras to store videos on to SD card during failures and stream it to the storage device after recovery.
6. Failover: A feature that automatically switches to a redundant or standby device upon failure or unexpected shutdown of an active device.

1.7 SUBMITTALS

A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner / Architect / Engineer.
b. Product Literature: Complete manufacturer’s product literature for all material, hardware, and equipment to be used in the installation of the specified system. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner / Designer) and the manufacturer’s supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
c. Construction Schedule: A time-scaled Construction Schedule, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
d. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the entire specification section. If the installer intends to deviate from any portion of the specifications, a

detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.

e. Each Submittal must have a detailed parts list. Quantities will not be required as the quantity of any portion of this system shall be as required for a complete and functional system and in conjunction with the contract documents.

f. Certifications: The contractor shall submit all certifications for approved products and the certifications must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.

1) Physical Security Professional (PSP) Certification: This certification must be held by an on-staff, full-time employee of the system installer. The holder must be staffed out of the office that is located within 75 miles of the projected.

2) Manufacturer Authorized Dealer Certification must be held by the system installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.

3) Installer Certifications: Certification indicating that an individual has successfully completed installer training, issued by the VMS and Cameras Manufacturers specified herein, must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.

B. Shop Drawings:

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:

a. Proposed cable routing and grouping plan.

b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:

1) Location of sleeved wall and floor pass-thru

2) Size of sleeve at each location installed

3) Quantity of cable passing through each sleeve

4) Location of devices and head end equipment.

6) Conduit routing, size, and quantity

c. Drawing Compliance: A letter shall be provided stating that the system installer complies with the entire project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. No deviations shall be acceptable until they have been approved by the Owner.

d. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.

C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.

D. Close-out Procedures:

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:

a. Inspection and Test Reports: During the course of the Project, the Contractor

shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.

b. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.

c. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.

d. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.

e. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

f. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.

g. All drawings must reflect final graphic numbering, point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.

h. A copy of the manufacturer's warranty on the installed system.

i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.

j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)

k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.

B. System Integrator shall provide the following as part of the System Solution:

1. Complete product and technical data specification sheets that include all material and equipment and shall be available freely online.
2. List of all equipment with part numbers, manufacturer, firmware, and assigned IP addresses.
3. Locations and details for all components to be installed under this scope of work.
4. Placement Diagram showing the proposed location of all system hardware devices.

5. System Calculation of all network bandwidth and storage requirements for System Servers to ensure proper planning of computing and networking infrastructure.

C. Installer Qualifications: Minimum 10-year experience installing similar products. Installers shall be trained and authorized by the Manufacturer to install, integrate, test, and commission the system.

1.9 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.11 PROJECT CONDITIONS

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

1.12 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.13 WARRANTY

A. The security system VMS software and labor furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance of the Video Surveillance System.

B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

C. Software Licensing and Warranty:
1. Software licensing should be on a per device basis (e.g. 1 x license for 1 IP Camera or I/O device) with no base license for additional features or capabilities.
2. The VMS Software should be completely free for live streaming or playback of offline media files (images, videos).
3. Lifetime software upgrades shall be provided by the Manufacturer without cost and without the need for an annual maintenance agreement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. ExacqVision
2. Genetec
3. Milestone
4. OnSSi
5. Salient
6. Video Insight as Manufactured by Panasonic
7. Wave
8. Axis

B. Requests for substitutions will be considered in accordance with provisions of Division 1

2.2 IP SERVER

A. IP Server shall be designed to run on a Windows platform, supporting both Desktop and Server class operating systems including Windows 7, 10(Pro), 2008 R2, 2012, 2016.

B. It shall run as a Window's Service. This service shall run as part of the local service account. This service shall be running as long as the system is booted and has started Windows. It shall not require the user to be logged in.

C. It shall store settings in SQL Express and shall not require a full MS-SQL license.

D. It shall have an option for a 32-bit binary and a true 64-bit binary. In a 64-bit OS, it shall run as a native 64-bit application, not merely a 32-bit application.

E. The service shall connect to the camera and handle streaming to the server. It shall not require each client to connect to individual cameras.

F. This service shall allow the cameras to be placed on one network and the clients on a separate network using a different IP range.

G. The software shall support the ONVIF standard.

H. The software shall support Megapixel virtual cameras within a single camera license.

I. The server shall only require two ports for streaming video as well as handling any setting changes or commands from the client software.

J. IP Server shall record the video streams from different cameras.
   1. The service shall handle transcoding of the camera streams if the cameras are MJPEG based. The video shall be re-encoded to WMV to reduce storage needs and to reduce the impact of streams to clients on the server.
   2. For MPEG-4 based cameras, the video shall be stored in the native codec of the server.
   3. For H.264/H.265 based cameras the video shall be stored in the native codec of the server.
   4. Each camera will have the option to be able to be stored in different locations (i.e. One locally, another on a NAS, a third on a different network share).
   5. Streaming from server to client shall support H.264/H.265.
   6. The server must have Pivot 3 integration.

K. IP Server shall support H.264/H.265, MPEG-4, MJPEG and MXPEG based cameras.

L. IP Server shall support motion detection at the camera and at the software levels.

M. IP Server shall provide graphic examples of what it determines as motion to thick clients if the thick client requests it.
1. The software shall display the motion detection as an outline around the area moving.
2. The software shall provide a bar showing the total percentage of change. This bar shall have a slider on it to allow the user to quickly set motion detection.

N. IP Server shall allow for multiple zones to be set within an image that support differing motion detection values within a cameras field of view.
1. There shall be no limit on the total number of zones allowed, either on a per camera or per server basis.
2. Zones should allow the ability to ignore motion within an area.
3. The user shall have the ability to move the zones after the fact.
4. Motion zones should be able to be tied into a rules engine to allow the software to use them as triggers for events.

O. IP Server shall support the use of imported maps to show camera placement. These formats for these maps will be JPG, GIF or BMP as determined by the user.
1. Hovering over a camera on a map shall cause it to be displayed in a window on the side.
2. When the camera is displayed on the side, the option to review recently recorded video will be available to them.
3. The user shall be able to embed layouts onto the facility map. Clicking on the layout shall change the display of the client software.
4. Alarms from DIOs shall be able to be embedded as well.
5. Audio sources shall also be an option.
6. Other facility maps shall also be an option to embed. Clicking on a different embedded map shall bring up that map.
7. Doors from certain access control systems can be imported and displayed. Hovering over the door shall display the last badge used to badge in, a live view of the camera associated with the door. The user from this pop up shall be able to see badge events and alarm events along with the associated video.

P. IP Server shall not require the administrator to contact the manufacturer to replace a camera.

Q. IP Server shall support reporting to a diagnostic tool.
1. Number of active cameras.
2. Active cameras offline.
3. Version of the server.
4. Amount of disk space left.
5. Recording status of the server.

R. IP Server shall support pre-motion and post motion recording.

S. IP Server shall support customizable layouts. The layouts will allow for blank spaces within the layout.

T. IP Server shall support an unlimited number of users.
1. Users can be drawn from either an Active Directory server, Novell eDirectory or entered manually.

2. There will be five different levels of user.
3. Users can be members of a group with settings set for the group. Individual user settings can override the group settings.
4. Permissions can be set for live viewing, access to recorded video, control of PTZ cameras, access to audio, the ability to export video, custom layouts, facility maps and rules. Permissions can be defined on a per camera basis.
5. It shall support the option of having the users limited to being signed in, to a single location.

U. IP Server will include a diagnostic version with limited interface, to allow for testing of the server.

V. It shall support an optional secondary server with failover capacity.

W. A rules engine shall be included to allow the server to handle more complex tasks.
1. Triggers will include:
   a. Dry contacts (DIO).
   b. Motion detection of a camera stream.
   c. Scheduled events. Events can be scheduled on daily, weekly, or monthly basis. Individual events can be handled as well.
   d. An Alert button for the user interaction in the VI Monitor.
   e. Inputs sent programmatically via appropriate APIs.
   f. Access control events from supported Access Control Vendors.
2. Actions will include:
   a. Logging the event.
   b. Opening or closing a dry contact.
   c. Sending an e-mail with a custom text message tied to the trigger. Multiple texts will be allowed for different triggers.
   d. Sending an e-mail with an AVI/MP4 clip from a selected camera.
   e. Sending an e-mail with a JPG file of a selected event from a camera.
   f. Opening a live window for a user who is viewing.
   g. Move a PTZ to a certain preset location.
   h. Force recording.
   i. Force recording with audio.
   j. Instant Replay.
   k. Sending video to a Network Decoder.
   l. Switching single camera or layout views.
   m. Message Instruction.
   o. Moving, copying or deleting of files.
   p. Execute a program or batch file.
   q. Send an ASCII string to a TCP port.

X. IP Server shall support time out functionality.
1. A universal RTSP option shall exist for adding cameras if they are not currently supported through native APIs.

Y. PTZ functionality within the camera will be supported.

Z. Dewarping of Panoramic shall be supported for the following manufacturers:
1. Advidia
2. AMG
3. Axis

4. Dahua
5. Hikvision
6. Oncam
7. Pelco
8. Panasonic
9. Sentry 360
10. Uniview
11. Vivotek
12. Dlink
13. Dynacolor
14. EverForcus
15. GridSmart
16. IDIS
17. ACTi
18. GeoVision
19. Hanwha
20. Samsung
21. ImmerVision

AA. IP Server will only stream video to the clients that requested them.

BB. If live video is paused, then IP Server shall stop streaming video to the clients to conserve bandwidth.

CC. IP Server shall support integration with various access control platforms, including:
1. Imron
2. MonitorCast v.3
3. MonitorCast v.4
4. AMAG
5. Badge Pass
6. Blackboard
7. Continental
8. Infinias
9. Isonas
10. Lenel
11. Paxton
12. CCURE
13. DSX
14. Gallagher
15. Maxxess
16. RBH
17. S2
18. Sureview

DD. IP Server shall have support panic button functionality through rules engine.

2.3 VI MONITORPLUS

A. VI MonitorPlus will be a thick client for viewing live and recorded video, along with handling administrative tasks.

B. The software shall not require a client license to operate.

C. The thick client will support an encrypted XML file for storing settings. The file can be set up to be shared between many clients, allowing the administrator to update all clients with a single file push.
   1. Clients will be able to use Active Directory to authenticate users.
   2. Clients will be able to use Novell E-directory to authenticate users.
   3. VI MonitorPlus shall have a searchable timeline for multiple events.
   4. Motion.
   5. Access Control (integration required).
   6. Rules.
   7. LPR (License Plate Recognition).
   8. VCA (Video Content Analytic).

D. VI MonitorPlus will display the servers it's connected to along with the server's cameras in a tree view on the left-hand side.
   1. The tree view will allow the user to see the status of the servers that the instance of VI MonitorPlus is aware of.
   2. The tree view will also include access to custom layouts, facility maps and action buttons.
   3. There will be an option to hide the tree on startup of VI MonitorPlus.
   4. The user shall be able search for cameras using a searchable box on the left-hand tree.

E. The thick client will not be limited in the number of servers it can connect to.

F. Live view will allow views of 1, 2, 4, 8, 9, 10, 13, 16, 25 and 36 cameras. A widescreen option for 18 and 24 cameras will also be available.
   1. Layouts will be selectable via icon.
   2. Layouts will not be limited to cameras from a single server.
   3. Users will be able to get layouts to cycle in the client's workspaces.
   4. Layouts shall be able to be put into groups.

G. If motion is detected on a camera, the software shall have the option to indicate it by highlighting the edge of the live window.

H. Live view will allow cameras to be dragged and dropped onto the live view from the left-hand tree. Cameras can be duplicated in a view.

I. Users will be able to invoke a digital zoom by drawing a box.

J. After invoking the digital zoom, VI MonitorPlus shall support the use of picture in picture within the zoomed image.

K. Digitally zoomed areas will be treated as a digital PTZ.

L. PTZ Presets shall be listed in a drop-down menu in the Dynamic Tab.

M. Users shall be able to move the PTZ movements simply by clicking on the image, through onscreen PTZ controls. Zoom functionality can also be controlled via the scroll wheel of the mouse.

N. Live view will support a full screen mode that hides the UI. User shall be able to start VI MonitorPlus in this full screen mode with a setting.

O. Live view shall allow the user to de-warp the video from panoramic lenses and cameras.

P. Right clicking on a camera in live view will have the following behaviors:
1. Right clicking on a camera within live view will allow the user to be able to review the recently recorded video for that camera.
2. Right clicking on a camera within live view will also allow access to the properties dialog box for that camera.
3. Right clicking on a camera will bring up the option to save a still image of the live view.
4. Live audio will be able to be accessed by right clicking on a camera in the live view.
5. Allowing access to recorded video.
6. Right-clicking on the Camera tile will allow the users to send video or messages to other users in the form of a popup window.

Q. Recorded video Synchronized playback will allow for cameras to simply be dragged and dropped into the player.

R. The exporting of video in VI MonitorPlus shall have Region of Interest capability within a recorded image. This will enable segregation of image for export.

S. The thick client will include a repair utility for corrupted video.

T. VI MonitorPlus will be able to display logging information such as: changes to the server, lost camera signals, who exported recorded video, when did users log-on/off and other errors. This functionality will be limited to administrative users. The log will be exportable as txt or to the Windows clipboard.

U. VI MonitorPlus shall also provide real time status updates for server status and camera status, including the CPU usage, disk usage, bandwidth usage, licensing and number and names of users who are logged in.

V. The system will support an Alarm Log to make it easier to find DIO based events.

W. Facility maps will be available in the software for viewing.
1. When the user hovers over a camera in the facility map it will display the camera in a window off the side of the map.
2. While a camera is displayed it will allow access to recorded video from that camera as well as the live stream.
3. Cameras will display where they are pointed.
4. Embedded layouts will change the layout of VI MonitorPlus if they are clicked on.
5. Embedded Facility maps will cause the current map to change to the embedded map if clicked on.
6. The user will have the option of importing and placing doors from supported access control partners on the map. This shall allow them to see badge events as well as alarm events. It shall also support the ability to lock and unlock doors from the map.
7. Integrated Panic button events will be visible on the facility map.

X. VI MonitorPlus will support the DCZ Joystick as well as standard USB joysticks.

Y. The software shall support the ability to open a live window that can be moved around. This window will be able to access the view of any camera or layout the user has access to.

Z. VI MonitorPlus will support multiple screen user environments for dynamic user interface.

AA. The user will be able to enable or disable the following settings:
1. Server name in the live view.
2. Camera Name in the live view.
3. Audio notification on motion.
4. Forcing aspect ratio.
5. Use Direct Show for display.
6. Double clicking to change the server layout.
7. Double clicking expands the camera.
8. Allowing multiple live windows.
9. Block live windows from popping up.
10. Live window always on top.
11. The speed in which layouts cycle.
12. Hiding left tree on start up.
13. Launching Facility maps on start up.

BB. Users with Administrator privileges will be able to configure the server and camera settings. Users will also be able to test SMTP settings and database settings.
1. Users will be able to configure the framerate of the camera, including the option to have the server record continuously from 1 to 3 fps with the option to go to the cameras designated frame rate on motion detection.
2. Users will be able to select various time-lapse options for the camera.
3. Users will be able to select the camera stream type.
4. Users will be able to select camera or server-side motion detection.

CC. Users will be able to access a graphic representation of what the server's motion detection settings are picking up through the timeline.

DD. Users will be able to configure user settings as well as layout settings from within the thick client.

EE. VI MonitorPlus will allow users to send video to other users, allowing for remote live pop ups of video of important events.

FF. VI MonitorPlus will support Layout touring. Selecting a layout will cycle through a list of cameras.

GG. User shall be able to allow for remote support via VI MonitorPlus.

HH. VI MonitorPlus will allow Region of Interest searches (a.k.a. SmartSearch functionality).

2.4 WEB CLIENT

A. The Web Client shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.

B. The Web Client shall be platform independent and run within Microsoft Edge, Internet Explorer, Firefox, Safari, and Google Chrome.

C. Users will not be able to change any settings within IP Server via the thin client without

Admin privileged.

D. Users will be able to select layouts for live viewing, or individual cameras or groups of cameras.

E. Users will be able to access recorded video.

F. Users will be able to download recorded video from the system.

G. Users will be able to use the motion log to find recorded video.

H. The Web Client shall support the use of facility maps.

I. The Web Client will support the use of custom layouts.

J. The Web Client shall allow remote access for iPhone, Blackberry, Windows Mobile, and Android mobile phones without the installation of an app.

2.5 HEALTH MONITOR

A. Front end, or by sending out an e-mail to one or more users.

2.6 VIDEO WALL

A. The VSS shall support video wall applications by connecting and controlling multiple workstations and monitors simultaneously.

2.7 VSS MOBILE APPLICATION

A. The VSS shall support module applications that run on the following Operating Systems:
   1. Google Android.
   2. Android 4.0: Ice Cream Sandwich thru the most current version
   3. Apple iOS: 5 thru the most current version

B. The App will have access to live cameras.

C. PTZ functionality will be available in the App.

D. The App will have access to recorded video.

E. Snapshots will be able to be e-mailed from the App.

2.8 SERVERS

A. Rackmount Servers:
   1. Server sizes and quantities shall be provided on storage and server calculations conducted by the system installer, based on the minimum parameters stated within the contract documents.
   2. Sever Requirements shall meet the specifications of the VSS Manufacturer. The following specifications shall be considered minimum requirements:
      a. Record Video and Audio: 470 Mbps.

b. Send data from video cameras to a hard disk array of 1 to 8 HDDs within a rack mountable format and enable playback of video and audio from the hard disk array.
   1) Pre-configured with VSS software.
   2) Remote monitoring environment for video and audio over network using a remote computer.
   3) SQLite, a free database technology included in the installation package.

c. General Properties:
   1) Camera Search and Discovery: Search network for connected compatible cameras via Onvif Profile S.
      a) Cameras are Searched or Discovered:
      b) Cameras automatically registered and current camera information (fps, days of recording) displayed.
      c) Ability to selectively register as many as cameras can be found.
   2) Support dual monitor out.
   3) Support server backup if multiple servers are in the hive for failover for redundancy.
   4) Recording and Playback Functions:
      a) Support recording 128 dual streams (256 streams) from 352 x 288 (CIF) up to 4000 X 3000 (12 MP) per channel.
      b) 470 Mbps network camera recording throughput.
      c) Simultaneous Playback Capability: 128 video channels.
      d) Compression Support: H.265, H.264, and MJPEG.
      e) NVR to record and stream AAC, PCM, g726, and MPS audio.
      f) View status of internal connected storage hardware.
      g) Set recording schedules.
      h) Set up triggered recording based on:
         (1) Sensor (input) detection.
         (2) Motion Detection.
         (3) Video loss detection.
      i) Available recording settings by channel for standard and event-based recording types:
         (1) Compression type.
         (2) Resolution.
         (3) Images per second.
         (4) Quality.
         (5) Data transfer limit.
         (6) Pre-event and post-event record duration.
         (7) I-frame and full frame recording.
      j) Available actions upon reaching full HDD storage capacity:
         (1) Stop recording.
         (2) Overwrite.
      k) Search recorded data by time, event trigger, motion alarms, events.
   5) Storage: Four, 8 TB HDDs in JBOD configuration for a maximum of

32TB.

a) USB connection for memory/storage device for video clip backup and settings export.

6) Live View:
   a) Remote monitoring using VSS supplied viewer.
   b) Streams: H.265, H.264, MJPEG.
   c) Offline Media: AVI, MKV, MP4, MOV, TS, M2TS, MPEG, MPG, FLV, WMV, 3GP, JPG, PNG, GIF, BMP, and TIFF.
   d) Configure and exercise functions for connected PTZ cameras, including functionality with compatible USB joystick.
   e) Capture and save snapshot images.
   f) Record current video in AVI format.
7) Remote Access:
   a) Multicast or Unicast: Simultaneous access is unlimited.
   b) Mobile Device:
      (1) Supported Platforms:
         (a) Andriod.
         (b) IOS.
      (2) Supported Remote Users: Unlimited amount either live or playback.
      (3) Dynamic DNS (DDNS) support.
8) VGA and High Definition (HDMI) local monitor outputs live viewing, playback, and backup functions.
9) ONVIF Profile S compliance.
10) Alarm Connections: None on server. Use of I/O software module to support I/O control.

d. System:
   1) Processor: Intel Core i5-7500 3.4 GHz.
   2) Memory: 8 GB DDR4.
   3) Operating Systems: Windows 10 IoT Enterprise.
   4) USB Ports: 4x USB 3.0(rear), 1x USB 3.0 Type-C (rear), 2x USB 2.0(front).
   5) Video Output: 2x HDMI (rear), 1x DVI (rear).
   6) Wi-Fi: IEEE 802.11ac.
   7) Other Ports: 1x PS2, 2x Wi-Fi Antennas, 3.5 mm audio in/out, 1x SPDIF out.
   8) Keyboard and Mouse: Included.
e. RAID Support: None.
f. Video Compression: H.265, H.264, and MJPEG.
g. Recording:
   1) Channel Capability: No limit but recommended to use VSS Calculator.
   2) Bit Rate: 470 Mbps.
   3) Resolution Range: 352 x 288 to 4000 X 3000.
h. Events and Response Actions:
   1) Triggers:
      a) Motion.
      b) Video loss.

c) Event defined by camera.

2) Response Actions:

a) Record.

b) E-mail.

c) Activate PTZ preset.

d) Event Trigger program.

e) Sound output.

i. Playback:

1) Number of simultaneous channels: Not limited.

2) Bandwidth: 470 Mbps.

j. OS Drive: OS Drive Bays: 1, 256 GB SSD internally mounted.

k. Storage:

1) Internal:

a) Number of HDDs Bays: 1 to 8 Bays

b) Capacity: 1 to 8 TB per HDD.

2) External Types: USB HDD/Flash drive for backup of video clips, firmware update, settings backup/restore, log export.

l. Network:

1) Connectivity: 1000 Base-T Ethernet, 2 x RJ-45 connectors.

2) Protocols Supported:

a) Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP).

b) Configuration: Dynamic Host Configuration Protocol (DHCP).

c) Web Services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS).

d) Network Services: Address Resolution Protocol (ARP), Domain Name System (DNS), Internet Control Message Protocol (ICMP): Network Time Protocol (NTP), Simple Network Management Protocol (SNMP v1/2c/3 – MIB-2), Universal Plug and Play (UPnP).

e) Media: Real-Time Transport Protocol (RTP), Real-Time Control Protocol, Real-Time Streaming Protocol (RTSP).

f) Multicast: Internet Group Management Protocol (IGMP).

g) Notifications: Simple Mail Transfer Protocol (SMTP).

h) Remote Access: Point-to-Point Protocol over Ethernet (PPPoE).

3) DDNS: Support DDNS services offered by the Manufacturer and other publicly available service offerings.

4) Security Features:

a) User password protection with group restrictions.

b) IP address filtering, list of allowed or blocked IP addresses.

c) HTTPS(SSL) login authentication.

d) User access log.

e) 802.1x authentication.

f) Restriction of network access/web viewer access.

5) Discovery: Manufacturer shall offer a discovery program to identify all devices of his manufacture on the network, as well as ONVIF

Profile S conformant devices.

m. Alarm/Sensor Interface:
   1) Input (0): NO or NC, selectable.
   2) Output (0): NO or NC, selectable.
   3) Use of I/O software module to support I/O control.

n. Audio:
   1) Direction: Bi-directional.
   2) Compression: AAC (16/48KHz), G.711 u-law, G.726 selectable.
   3) Output: Line level (RCA).
   4) Output: Line level (RCA).

o. Electrical:
   1) Power:100 to 240 VAC.
   2) Power Supply: 800 W Redundant.

p. Mechanical and Environmental:
   1) Color: Black / metal.
   2) Front Bezel and lock.
   3) Form Factor2U Rack Mount Chassis. Sliding rails included.
   4) Mouse and Keyboard: Included.
   5) Dimensions (W x H x D): 17.2 x 3.5 x 26 inch (438 x 87.0 x 660 mm)
   6) Weight: 30.86 lbs. (14kg).
   7) Temperature; Operating and Storage: 32 to 122 degrees F (0 to 50 degrees C)
   8) Humidity: 5 to 85 percent, RH non-condensing.

B. All equipment shall be delivered to the site following the schedule provided. Provide full manufactures warranty for all server equipment.

C. Servers shall be preprogrammed to include a floor plan graphic of all applicable sites and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.

D. In response to proposal, contractor shall provide owner with amounts for annual service maintenance agreement that can be purchased after warranty period has expired.

2.9 CLIENT WORKSTATIONS

A. Contractor to provide one (1) client workstation with the installation location to be determined at the time of install. Additional workstation will be furnished by the Owner as required.

B. Contractor shall include configuration of two (2) additional, owner furnished workstations.

2.10 CAMERAS

A. Camera Types:
   1. Tamper resistant with all movable parts enclosed behind a protective cover.
   2. Integrated Dome In-Ceiling flush mount.
   3. Water resistant.
   4. 3-year warranty on all cameras.

B. Color Cameras
1. Acceptable Manufacturers:
a. Axis
b. Hanwha
c. Panasonic
d. Reference Video Surveillance Camera Schedule for model numbers, accessories, and additional information.

C. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.

2.11 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED

A. Licensing
1. Provide the owner with all licenses as required for installation

PART 3 - EXECUTION

3.1 PREPARATION

A. System Integrator: Confirm the solution proposal planning and design with the installing contractor.

B. The network design and configuration to be verified for compatibility and performance with the input/output devices.

C. Network Configuration: Tested and qualified by Contractor prior to remote device installation.

D. Equipment to be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

E. All firmware found in products to be the latest and most up to date provided by the manufacturer, or of a version as specified by the provider of the Video Management Application (VMA).

F. All equipment requiring users to log on using a password to be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

G. Confirm hardware will be stored in an environment where temperature and humidity are in the range specified by the Manufacturer.

3.2 INSTALLATION

A. General
1. Install products per manufacturer's recommendations and approved submittals.
a. Comply with documentation provided by the System Integrator to ensure all steps have been taken to provide a reliable, easy-to-operate system.
2. Contractor personnel must comply with all applicable state and local licensing requirements.
3. Before permanent installation of the system, the Contractor will test the system in

conditions simulating the final installed environment witnessed by the System Integrator. Adjust as required until proper operation is achieved.

B. Cable Support:
1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
3. Cable support shall be installed at a maximum of 5' on center.
4. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.
5. Absolutely no cable, not installed in conduit, will be allowed to be attached directly to the building's steel or supported in any other method than that stated above.
6. It is the responsibility of the installing contractor to coordinate with all other trades on the project to insure that the pathway of this system does not interfere with the installation of the other trades and to prevent the installed product of other trades from putting strain on the installed wiring.
7. Do not route cable through webbing of structural steel.

C. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.

D. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.

E. Wall Penetrations: Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.

F. Provide three-sided pre-finished metal hood and seal to wall where conduit penetrates exterior wall.

G. Install new roof mounted conduits on portable pipe supports – (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof

protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.

H. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom)

3.3 EQUIPMENT RACK CONFIGURATION

A. Cable Placement: Cable installation in the wiring closet 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 location. 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 a working distance from these openings.

B. Cable shall be routed as closely as possible to the ceiling, floor or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the wiring closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.

C. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.

3.4 WIRING INSTALLATION

A. General:
1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
2. All cable must be handled with care during installation so as not to change performance specifications.

B. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner’s efficient use of their full capacity.

3.5 DOCUMENTATION

A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8”) in height, block. All labels shall correspond to as-builts and to final test reports.

B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner’s labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.

C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.

D. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

3.6 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.

B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.

C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.

D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

3.7 INSPECTION

A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Architect/Engineer may observe before acceptance.

3.8 WARRANTY

A. Guarantee and warrant all equipment provided for a period of 3 years following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration.

B. All such warranties shall include all parts (DVR's, and Power Supplies).

C. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion

END OF SECTION

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location determined by the Project Engineer.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify utility locator service (Call Before You Dig) for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation- control and tree-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches (50 mm) in diameter, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be

stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot (300 mm) across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches (900 mm).
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, and turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" and Section 013233 "Photographic Documentation" for recording preexcavation and earth-moving progress.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
4. Section 316329 "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
5. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
6. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Quantity allowances for earth moving are included in Section 012100 "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches (600 mm) outside of concrete forms other than at footings.
2. 12 inches (300 mm) outside of concrete forms at footings.
3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

5. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992- lbf

(213.3-kN) breakout force with a general-purpose bare bucket.

2. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at location determined by the Project Engineer.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698 ASTM D1557.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service ("Call Before You Dig") for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487 Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: 20.
2. Plasticity Index: 20.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1- 1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.

J. Sand: ASTM C33/C33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

a. Class 2; AASHTO M 288.
b. As follows:

1) Grab Tensile Strength: 157 lbf (700 N); ASTM D4632.
2) Sewn Seam Strength: 142 lbf (630 N); ASTM D4632.
3) Tear Strength: 56 lbf (250 N); ASTM D4533.
4) Puncture Strength: 56 lbf (250 N); ASTM D4833.

c. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D4751.
d. Permittivity: 0.5 per second, minimum; ASTM D4491.
e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

a. Class 2; AASHTO M 288.
b. As follows:

1) Grab Tensile Strength: 247 lbf (1100 N); ASTM D4632.
2) Sewn Seam Strength: 222 lbf (990 N); ASTM D4632.
3) Tear Strength: 90 lbf (400 N); ASTM D4533.
4) Puncture Strength: 90 lbf (400 N); ASTM D4833.

c. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D4751.
d. Permittivity: 0.02 per second, minimum; ASTM D4491.
e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. Do not use explosives.
2. Obtain written permission from authorities having jurisdiction before bringing explosives

to Project site or using explosives on Project site.

a. Perform blasting without damaging adjacent structures, property, or site improvements.
b. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches (600 mm) outside of concrete forms other than at footings.
b. 12 inches (300 mm) outside of concrete forms at footings.
c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches (150 mm) beneath bottom of concrete slabs-on- grade.
f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches (600 mm) outside of concrete forms other than at footings.
b. 12 inches (300 mm) outside of concrete forms at footings.
c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches (150 mm) beneath bottom of concrete slabs-on- grade.

f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms:

1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

a. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
b. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
d. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2. Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

a. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch- (100-mm-) thick, concrete- base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698 ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.18 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D698 with a minimum of two passes of a plate-type vibratory compactor.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer **to 85 percent of maximum dry unit weight according to ASTM D698 with a minimum of two passes of a plate-type vibratory compactor**.
2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698 ASTM D1557.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs- on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with

requirements.

2. Determine that fill material classification and maximum lift thickness comply with requirements.
3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving including the following:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
4. Section 321713 "Parking Bumpers."
5. Section 321716 "Manufactured Traffic-Calming Devices."
6. Section 321723 "Pavement Markings."
7. Section 321726 "Tactile Warning Surfacing" for detectable warning tiles.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location determined by the Project Engineer.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.

b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving Subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. Exposed Aggregate: 10-lb (4.5-kg) Sample of each mix.

D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of stamped detectable warnings, ready-mix concrete manufacturer, and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-

mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. 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 mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches (2400 mm) by 96 inches (2400 mm).
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars.

G. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 (Grade 420) deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A1064/A1064M.

I. Deformed-Steel Wire: ASTM A1064/A1064M.

J. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, plain.

K. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 (Grade 420) plain-steel bars.

M. Tie Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

N. Hook Bolts: ASTM A307, Grade A (ASTM F568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and

in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, gray portland cement Type I and/or Type II.
2. Fly Ash: ASTM C618, Class C or Class F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan, or Type IL, Portland-limestone cement.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service- record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 1/2 to 3/4 inch (13 to 19 mm) nominal.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

G. Water: Potable and complying with ASTM C94/C94M.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

B. Synthetic Fiber, Fibrillated Fibers: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1- 1/2 inches (13 to 38 mm) long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

2.7 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber, ASTM D1752, cork or self-expanding cork, or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (3 to 6 mm).

F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Color: As selected by Architect from manufacturer's full range.

G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch (9.5-mm) sieve and 85 percent retained on a No. 8 (2.36-mm) sieve.

2.8 STAMPED DETECTABLE WARNING MATERIALS

A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.

1. Size of Stamp: One piece, matching detectable warning area shown on Drawings.

B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete

design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Slag Cement: 50 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content, 1-1/2-inch (38-mm) Nominal Maximum Aggregate Size: 4-1/2 percent plus or minus 1-1/2 percent.
2. Air Content, 1-inch (25-mm) Nominal Maximum Aggregate Size: 4-1/2 percent plus or minus 1-1/2 percent.
3. Air Content, 3/4-inch (19-mm) Nominal Maximum Aggregate Size: 5 percent plus or minus 1-1/2 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

H. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum W/C Ratio at Point of Placement: 0.53.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or

clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/8-inch radius. Repeat grooving of contraction joints after applying surface finishes.

   a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until

cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch (1.6 mm).

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
4. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

D. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer to match paving color required.
2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
3. After final power floating, apply a hand-troweled finish followed by a broom finish.
4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.9 INSTALLATION OF DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."

1. Tolerance for Opening Size: Plus 1/4 inch (6 mm), no minus.

B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. Before using stamp mats, verify that the vent holes are unobstructed.
2. Apply liquid release agent to the concrete surface and the stamp mat.
3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
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.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-feet- (3-m-) long; unleveled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
6. Vertical Alignment of Dowels: 1/4 inch (6 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28- day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321316 - DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Colored concrete paving.

B. Related Requirements:

1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and other paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.

C. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production

facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. 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 mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 48 inches by 48 inches
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420); deformed.

2.4 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 C150, gray portland cement Type I.
2. Fly Ash: ASTM C618, Class F.
3. Slag Cement: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
3. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.

F. Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water- reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Basis if Design: Dry Integral Color “417 Brick Red” by Solomon Colors or approved equal.

Additional suppliers include:

a. Alabama Pigments Company, LLC.
b. Brickform; a division of Solomon Colors.
c. Butterfield Color, Inc.
d. Scofield, a Business Unit of Sika Corporation.
e. Stampcrete International, Ltd.

G. Water: Potable and complying with ASTM C94.

2.5 CURING AND SEALING MATERIALS

A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, and complying with ASTM C171.

B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

C. Clear Acrylic Sealer, Low-to-Medium Gloss: Manufacturer's standard, waterborne, non-yellowing and UV-resistant, membrane-forming, acrylic copolymer emulsion or epoxy- modified acrylic emulsion, manufactured for colored concrete, containing not less than 15 percent solids by volume.

2.6 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Slag Cement: 50 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content:

a. 5 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

H. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4000 psi
2. Maximum W/C Ratio at Point of Placement: 0.45
3. Slump Limit: 4 inches plus or minus 1 inch

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94 and ASTM C1116. Furnish batch certificates for each batch discharged and used in the Work.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below decorative concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines,

grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as

indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows**, to match jointing of existing adjacent decorative concrete paving**:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving- tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven

floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Compound: Apply immediately after final finishing. 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.

1. Cure integrally colored concrete with a curing compound.

F. Curing and Sealing 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 SEALER APPLICATION

A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/8 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
4. Joint Spacing: as shown on drawings.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321316

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Cold-applied, fuel-resistant joint sealants.
4. Hot-applied, fuel-resistant joint sealants.
5. Joint-sealant backer materials.
6. Primers.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.3 FIELD 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.
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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, 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.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant, Type I: ASTM D6690.

B. Hot-Applied, Single-Component Joint Sealant, Type I or Type II: ASTM D6690.

C. Hot-Applied, Single-Component Joint Sealant, Type I, II, or III: ASTM D6690.

D. Hot-Applied, Single-Component Joint Sealant, Type IV: ASTM D6690.

2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 12-1/2, for Use T.

2.5 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants, Type I or Type II: ASTM D7116.

B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants, Type III: ASTM D7116.

2.6 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints 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.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint 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 joint-sealant backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Painted markings applied to concrete surfaces.

B. Related Requirements:

1. Section 071800 "Traffic Coatings" for painting whole areas of building floors and pavements with coatings having an integral wearing surface.
2. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement markings.
3. Section 099123 "Interior Painting" for painting interior concrete surfaces other than pavement markings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at location determined by the Project Engineer.

1. Review methods and procedures related to marking asphalt paving or concrete surfaces including, but not limited to, the following:

a. Asphalt-paving or concrete-surface aging period before application of pavement markings.
b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement-marking paint, alkyd.
2. Pavement-marking paint, solvent-borne.
3. Pavement-marking paint, acrylic.
4. Pavement-marking paint, latex.
5. Glass beads.

B. Shop Drawings:

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches (200 mm) square.

1.5 GENERAL

A. The Contractor shall furnish all of the necessary trained personnel, sufficient equipment, proper traffic control and all materials, including reflectorized glass spheres, to install pavement markings at specified locations within East Baton Rouge Parish.

B. The Contractor shall provide written certification that all materials used in this contract meet the specifications contained herein. This certifications must be submitted at the pre-construction conference.

C. The Contractor shall lay out and install all pavement markings, according to the Manual on Uniform Traffic Control Devices (MUTCD) latest edition, the plans and subject to approval of the City of Baton Rouge, Parish of East Baton Rouge, Department of Public Works, Traffic Engineering Division (CP/DPW/TED). The CP/DPW/TED offices shall be notified upon completion of any new pavement marking layout work for inspection prior to the application of any pavement markings.

D. The Contractor shall maintain a written detailed daily log of work completed. The log shall show the location (by street name, including termini), time and date that each type work (i.e., removal, layout, application) begins and ends on each street or separate street segment. If work is performed on the same street or street segment on more than one day or at different times on the same day, the beginning and ending time for each activity performed shall be shown as a separate entry. Duplicate copies of daily work sheets containing the information shown above for all work completed on each street segment, each day, will be maintained and signed by the City/Parish and contractors representatives. Any change over or under ten percent (10%) in estimated versus actual quantities must be approved and a field change order sheet completed and signed at the end of each work day by both representatives.

E. The same type of pavement marking material (i.e., same manufacturer and composition) shall be used throughout a single roadway project. Variations with regards to this requirement may be allowed by verbal permission, to be confirmed in writing within forty-eight (48) hours, from the CP/DPW/TED.

F. No payment will be made for any work done without the presence of the CP/DPW/TED designated representative or an acceptable alternate on the site provide sufficient advance notice of all planned activities to permit scheduling of City/Parish representatives. Separate operations at more than two (2) different locations cannot be planned without advance written approval of the CP/DPW/TED or City/Parish representative. Price quoted by contractor shall include the cost of removal of all temporary pavement markings at no additional cost to the City/Parish.

PART 2 - PRODUCTS

2.1 GENERAL

A. Selection of the proper equipment to produce satisfactory results within the following basic requirements shall be the responsibility of the Contractor.

Applicator equipment for longitudinal lines shall consist of a self-contained, selfpropelled mobile unit that does not require the operator to walk behind or beside during the installation of pavement markings either left or right of the application unit so that only one (1) lane of traffic will be occupied. The applicator unit shall have a tachometer or other approved device to insure uniform application at the required rate. It shall be adjustable for applying one (1), two (2) or three (3) adjacent lines simultaneously at the specified spacing.

Applicators shall produce sharply defined lines and provide means for cleanly cutting off square stripe ends and applying broken lines.

Applications for longitudinal lines shall permit traffic to pass within the limit of the roadway surface and shoulder while the unit is operating.

Equipment shall be capable of producing continuous uniformity in dimensions of stripes. Equipment shall produce varying widths of traffic markings.

2.2 THERMOPLASTIC PAVEMENT MARKINGS

A. Hot thermoplastic pavement marking materials shall be applied to pavement by spray, ribbon gun or extrusion methods. Equipment shall provide continuous mixing and agitation of material. Conveying parts of equipment between main material reservoir and discharge mechanism shall prevent accumulation and clogging. Parts of equipment which come in contact with the material shall be easily accessible for cleaning and maintaining. Mixing and conveying parts shall maintain material at the plastic temperature, minimum three hundred and fifty (350) °F [one hundred and seventy-seven (177) °C].

B. Heating kettles to hold a minimum of one thousand (1,000) pounds of material shall be provided for melting and heating thermoplastic material. Kettles must be equipped with automatic thermostatic control devices so that heating can be done by controlled heat transfer liquid or other approved methods (no direct flame will be allowed) to provide positive temperature control and prevent overheating of material. A direct reading temperature gauge will be provided on each kettle so that the temperature of material can be observed and recorded.

C. Applicators and kettles must be equipped and arranged to comply with requirements of the National Board of Fire Underwriters. Applicators shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in true arc.

D. The contractor at his option may provide a hand held infrared temperature gauge to measure the surface and material temperature in lieu of the direct reading temperature gauge specified above. This device will be given to the City-Parish representative with proper operating guidelines and manuals at the preconstruction conference. The device will be returned to the contractor when the final inspection of all work has been completed. The cost of this device will be absorbed by the contractor in lieu of supplying the direct reading temperature gauge on the application equipment.

2.3 PAINTING EQUIPMENT

A. Painting equipment shall provide for the application of “drop-on” glass spheres.

2.4 SYMBOLS, LEGENDS AND CROSSWALKS

A. Applicator equipment for symbols, legends, and crosswalks, may be hand propelled, but must meet all other requirements indicated above.

PART 3 - EXECUTION

3.1 TIME AND WEATHER LIMITATIONS

A. No work that interferes with the movement of traffic shall be permitted during weekday peak traffic hours, unless authorized by the CP/DPW/TED or City-Parish representative in writing. Peak traffic hours are:
   1. 7:30 a.m. – 8:30 a.m., Monday thru Friday
   2. 4:30 p.m. – 5:30 p.m., Monday thru Friday

   Work during these hours on weekend days (Saturday and Sunday) may be authorized on an individual location basis by the CP/DPW/TED or City-Parish representative.

B. Application of markings will not be permitted when there is moisture on the pavement surface nor when the surface temperature is below fifty (50) °F Temperature will be measured and recorded at the start of each application and at approximately one (1) hour intervals.

C. Application of hot thermoplastic markings will not be permitted when the material temperature in the application equipment is below three hundred and seventy five (375) °F for extruded or ribbon-gun applications and four hundred (400) °F for spray applications. Temperature will be recorded at the start of each application and at approximately one (1) hour intervals thereafter.

3.2 CLEANING OF PAVEMENT SURFACES

A. Surfaces on which pavement markings are to be applied shall be cleaned of all materials that would reduce adhesion of the marking materials to the pavement. Cleaning shall be done by approved methods and surfaces shall be kept clean until placement of markings.

B. All existing temporary markings shall be removed. No direct payment will be made for removing existing temporary markings and costs shall be included in the price for other items.

C. Existing permanent marking on the roadway may not require removal prior to placement of new markings. The CP/DPW/TED and/or City-Parish representative will examine and test existing pavement markings to determine if removal is necessary (see subsection 1195-6). The decision of the Traffic Engineering/ City-Parish representative will be final and the contractor will remove any existing permanent pavement markings as directed.

D. At the end of each day’s operations, temporary pavement markings conforming to Subsection 905-3.2.1 shall be placed in areas where existing markings have been removed and new markings not placed. Temporary pavement markings shall be satisfactorily removed prior to resuming plastic striping operations. No direct payment will be made for the installation and removal of temporary markings and the cost shall be included in the price bid on other items.

3.3 REMOVAL OF EXISTING PAVEMENT MARKINGS

A. The contractor will be required to remove any permanent pavement markings (painted, thermoplastic or semi-permanent tape) when directed to do so by the CP/DPW/TED or City-Parish Representative.

B. CP/DPW/TED or City –Parish representative will make the final determination on removal of existing pavement marking based on field observations and a field test performed by the Contractors as follows:

1. On a typical ten foot (10') long segment of existing pavement marking stripe or a typical legend or symbol, a steel wire brush will be vigorously applied across the existing pavement marking material.

    - If the existing pavement marking material remains firmly adhered to the pavement surface and does not powder or crack or flake, then removal is not required. A simple cleaning with a power brush or compressed air to remove surface dirt and debris will still be required at no additional cost
    - If the existing pavement marking material shows loss of adhesion or significant powdering, cracking, or flaking, it shall be removed by approved methods which do not significantly damage the pavement surface to the extent that at least seventy-five percent (75%) of the pavement surface is exposed

C. When any existing pavement markings are not completely recovered the application of new pavement markings, it shall be removed by approved methods so that at least seventy five percent (75%) of the pavement surface is exposed. Compensation will be at unit cost bid for such removal.

3.4 LOCATION & DIMENSIONS

A. Pavement Markings (lines, legends, and symbols) shall have the following MUTCD dimensions and patterns, unless specified differently in these specifications or as directed by the Traffic Engineer.

1. All solid and skip-lane lines shall be four (4) inches wide. A skip-line shall consist of ten (10) foot line segments and thirty (30) foot gap segments. A dotted line shall consist of two (2) foot line segments and four (4) foot gap segments.

2. Legends and Symbols

    - All symbols, words and legends shall conform to the "Manual on Uniform Traffic Control Devices" as shown below:

Description	MUTCD Reference
Single Head Arrow	Section 3B-20, Fig 3-18 (a) or (b)
"Only"	Section 3B-20, Fig. 3-17

3.5 APPLICATIONS OF MARKINGS

A. Material shall be installed in specified widths from four (4) to twenty- four (24) inches. Finished lines shall have well defined edges and be free of waviness. Measurements shall be taken as an average throughout any thirty-six (36) inch section of line. Longitudinal lines shall be offset

approximately two (2) inches from construction joints of Portland Cement concrete pavement.

1. Tolerances: A tolerance of plus one-half (+1/2) inch or minus one eight (-1/8) inch from the specified width will be allowed, provided the variation is gradual and does not detract from the general appearance. Segments of broken line may vary up to plus or minus six (+- 6) inches from the specified length. Segments shall square off at each end without mist or drip. Variations from the control guide up to one (1) inch will be allowed proved the variation does not increase or decrease at a rate of more than 1(/2) inch in twenty-five (25) feet. Lines do not meet these tolerances shall be removed and replaced without additional compensation.

2. Protection of Markings: During and immediately following the removal and/or application of the striping in areas having public traffic; traffic cones; red flags supported by springs or heavy wire on pedestals, or other approved devices, shall be placed alongside or over the line at intervals not exceeding fifty (50) feet to remain in place until the stripe has dried to such an extent that it will not be picked up by the tires of vehicles. Traffic shall be prevented from crossing a wet traffic stripe and if the above provisions are not sufficient to prevent such, the contractor shall use a sufficient number of flagmen, prober boards, signs or other protection for the wet stripe, or he shall reduce the amount of wet line by slowing down the striping operation. Sections of traffic stripe which have been marred or picked up by traffic crossing before drying shall be repaired by the Contractor and the pavement cleaned outside the stripe without extra compensation.

3. Protection of Traffic: the contractor shall furnish and place all warning and directional signs required to direct, control and protect the traveling public while marking operations are in progress. Traffic shall be maintained at all times through the area where the stripes are being placed.

   The pavement striping train shall move in the direction of normal traffic flow. The trailing vehicle shall be equipped with approved flashing arrow boards capable of directing traffic to the appropriate side of the train. All traffic control signs, cones and equipment shall be removed from the roadway when the striping train is not in operation.

3.6 THERMOPLASTIC MARKINGS

A. Thickness and Temperature

1. Type I: The thickness of material on the pavement for Type I Thermoplastic Markings shall be not less than ninety (90) mils for lane lines, edge lines and gore markings and not less than one hundred and twenty-five (125) mils for crosswalks, stop lines, legends, and symbol markings, except that edge lines shall be thirty (30) mils when so designated by the plans, specification or Engineer.

   Type I Thermoplastic material shall be applied either by extrusion at three hundred ninety degrees Fahrenheit to four hundred fifty degrees Fahrenheit (390 °F to 450 °F), or by spray at four hundred ten degrees Fahrenheit to four hundred fifty degrees Fahrenheit (410 °F to 450 °F). Material shall not scorch or discolor if kept at this temperature for four (4) hours or if reheated to this temperature four (4) separate times.

2. Type II: The thickness of material on the pavement for Type II Thermoplastic Markings shall be not less than ninety (30) mils for lane lines, edge lines and gore markings and not less than sixty (60) mils for crosswalks, stop lines, legends, and symbol markings.

Type II Thermoplastic material shall be applied either by extrusion or ribbon gun at three hundred seventy-five degrees Fahrenheit to four hundred twenty-five degrees Fahrenheit (375 °F to 425 °F) or by spray at four hundred degrees Fahrenheit to four hundred twenty-five degrees Fahrenheit (400 °F to 425 °F). Material shall not scorch or discolor if kept at this temperature for four (4) hours or if reheated to this temperature four (4) separate times.

3. Type III: The thickness of material on the pavement for Type III Thermoplastic Markings shall not be less than thirty (30) mils for lane lines, edge lines and gore markings and not less than one hundred twenty-five (125) mils for crosswalks, stop lines, legends and symbol markings.

   Method of application and temperatures for 30 mil markings shall be as specified for Type II Markings and for 125 mil markings shall be as specified for Type I Markings.

4. Temperature will be checked and recorded at the start of each application and at approximately one (1) hour intervals thereafter.

B. Application on Portland Cement Concrete Surfaces

1. For application of hot thermoplastic material on new or unweathered Portland cement concrete pavement surfaces the Contractor will be required to treat the surface with primer of a type recommended and approve by the thermoplastic material manufacturer. The primer must be applied sufficiently in advance of the hot thermoplastic material to cure as required. The application of primer may be either a separate operation or combined with the application of the hot thermoplastic material subject to limitation on “curing” above.

2. On other pavement surfaces, if recommended by the material manufacturer, binder-sealer material shall be applied to the road surface prior to thermoplastic installation.

3. For application of hot thermoplastic material on existing Portland Cement concrete pavement where pavement markings have previously been placed, the new material may be placed directly on the existing material or surface subject to the requirements concerning the “Cleaning of Pavement Surfaces” in Subsection 1195-5.

C. Reflectorized glass spheres shall be applied to the surface of completed thermoplastic pavement markings by an automatic sphere dispenser attached to the striping machine in such a manner that reflectorized glass spheres are dispensed almost simultaneously at a uniform rate of a minimum of five (5) pounds of reflectorized glass spheres per one hundred (100) square feet of line. Reflectorized glass spheres shall be sprayed or dropped onto thermoplastic material while it is in a molten state immediately after it has been applied to the pavement. The reflectorized glass sphere dispenser shall be equipped with an automatic cutoff control synchronized with cutoff of thermoplastic material.

3.7 CONTRACTOR QUALIFICATIONS

A. The Contractor or subcontractor performing work under this contract must employ competent field level supervision with experience in the layout and applications of pavement markings, shall utilize equipment appropriate for the work, and must have performed other projects of a similar size and nature. References to verify these qualifications are met shall be provided within seven (7) calendar days to substantiate Contractor’s experience. Also, a list of equipment which will be utilized for the work must be submitted upon request. It is not the intent of this specification to exclude any qualified contractor, but a reasonable amount of experience is required in highway and urban area municipal striping.

B. The Contractor's attention is specifically directed to the following:

1. Application of all pavement markings will occur while normal traffic movement is being maintained on the street.

2. The project may require the layout of new pavement markings include "No Passing" zones (in accordance with Subsection 1195-7b for horizontal and vertical curves. The Contractor must have personnel capable of performing these layouts.

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Surface-applied detectable warning tiles.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds.

B. Weather Limitations for Adhesive Application:
1. Apply adhesive only when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (2 deg C) for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces 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 and wear.
b. Separation or delamination of materials and components.

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

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

A. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

1. Basis of Design: Surface Applied Tactile Warning Surface Tile by ADA Solutions, LLC or approved equal, other suppliers include:

a. Access Products, Inc.
b. Engineered Plastics Inc.; Armor-Tile.

2. Material: Molded glass- and carbon- fiber-reinforced polyester.
3. Color: Brick Red (R), Color No. 20109 in accordance with Federal Standard 595B Table IV.
4. Shapes and Sizes:

a. Rectangular panel, 24 by 24 inches

5. Dome Spacing and Configuration: 2.35-inch in square pattern.
6. Mounting: Adhered and fastened to existing concrete walkway.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

1. Furnish color-appropriate nylon sleeve, stainless steel fasteners for exterior us

2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Surface-Applied Detectable Warning Tiles:

1. Lay out detectable warning tiles as indicated and mark concrete pavement.
2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.
6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

3.4 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable

to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Decorative steel fences.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 DECORATIVE STEEL FENCES

A. Basis of Design: Montage Plus Magestic by Ameristar Fence or approved equal.

1. Ameristar Fence Products
   1555 N. Mingo Rd
   Tulsa, OK 74116
   Phone: (888) 333-3422
   Web: www.ameristarfence.com

2. Alumni-Guard
   2401 Corporate Blvd
   Brooksville, FL 34604
   Phone: (877) 258-6448.
   Fax: (354) 544-8442.
   Email: info@alumi-guard.com
   Web: www.alumi-guard.com.

3. Or approved equal.

B. Decorative Steel Fences: Fences made from steel tubing.

C. Posts: Square steel tubing.

1. Line Posts: 2-1/2 by 2-1/2 inches with 16 ga wall thickness
2. End and Corner Posts: : 2-1/2 by 2-1/2 inches with 16 ga wall thickness

D. Rails:
1. Steel Tube Rails: Square steel tubing 1-1/2 by 1-1/2 inches with 14 ga wall thickness

E. Pickets: 3/4 inch square by 18 ga wall thickness

1. Terminate tops of pickets at top rail for flush top appearance
2. Picket Spacing: 3-15/16 inches clear, maximum.

F. Finish Color: Black

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening panels to posts.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in

position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect above ground portion of posts from concrete splatter.

    a. Exposed Concrete: Concrete shall be flush with finish grade. Finish and slope top surface to drain water away from post.

END OF SECTION 323119

SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Seating.
2. Bicycle racks.
3. Trash receptacles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For site furnishings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SEATING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Basis of Design: Austin Bench by Landscape Forms, Inc.;
2. Acceptable Manufacturers:
   a. Landscape Forms, Inc.
      7800 E. Michigan Ave., Kalamazoo, Michigan 49048
      Phone: (800) 521-2546
      Fax: (269) 381-3455
      website: www.landscapeforms.com
      email: specify@landscapeforms.com
   b. Forms+Surfaces
      30 Pine Street, Pittsburgh, PA 15223
      phone: 800-451-0410, fax: 412-781-7840

email: sales@forms-surfaces.com
website: www.forms-surfaces.com

c. DuMor
PO Box 142, Mifflintown, Pennsylvania 17059
Phone: (800) 598-4018
website: www.dumor.com
email: sales@dumor.com

B. Style: Backless

C. Seat:

1. Material: Aluminum: Extruded aluminum boards for the face and interior seats are clear anodized (202-R1) and powder coated.

2. Arms: At ends, center

D. Metal Finish: Powder coated.

1. Color: Silver.

E. Attachment: Surface mount per manufacturer's recommendations.

2.2 BIKE RACK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

B. Basis of Design: Bola by Landscape Forms, Inc.;

C. Acceptable Manufacturers:

a. Landscape Forms, Inc.
7800 E. Michigan Ave., Kalamazoo, Michigan 49048
Phone: (800) 521-2546
Fax: (269) 381-3455
website: www.landscapeforms.com
email: specify@landscapeforms.com

b. Forms+Surfaces
30 Pine Street, Pittsburgh, PA 15223
phone: 800-451-0410, fax: 412-781-7840
email: sales@forms-surfaces.com
website: www.forms-surfaces.com

c. Dero
42 Northern Stacks Drive, Suite 100, Minneapolis, Minnesota 55421
Phone: (888) 337-6729
website: www.dero.com
email: jason@dero.com

D. Material: Stainless steel, Type 304 ASTM A554: Outside diameter: 1.5", wall thickness: 0.102"-0.112"

E. Steel Finish: Electropolish finish.

F. Attachment: Embedded per manufacturer's recommendations.

2.3 LITTER RECEPTACLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Basis of Design: Chase Park by Landscape Forms, Inc.;

2. Acceptable Manufacturers:

a. Landscape Forms, Inc.
7800 E. Michigan Ave., Kalamazoo, Michigan 49048
Phone: (800) 521-2546
Fax: (269) 381-3455
website: www.landscapeforms.com
email: specify@landscapeforms.com

b. Forms+Surfaces
30 Pine Street, Pittsburgh, PA 15223
phone: 800-451-0410, fax: 412-781-7840
email: sales@forms-surfaces.com
website: www.forms-surfaces.com

c. DuMor
PO Box 142, Mifflintown, Pennsylvania 17059
Phone: (800) 598-4018
website: www.dumor.com
email: sales@dumor.com

B. Style: Side-opening style.

C. Size: 24” diameter, 36 gallon capacity

D. Steel Finish: Powder coated.

1. Color: Silver

E. Attachment: Surface mount per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

END OF SECTION 323300

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 329300 "Plants" for placing planting soil for plantings.
4. Section 329600 "Transplanting" for placing planting soil in tree planting pits.

1.3 ALLOWANCES

A. Field quality-control testing is part of testing and inspecting allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.5 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed

leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to

SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart (1-L) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.10 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Architect under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples where directed by Architect for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.11 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT SERA-6, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

C. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

D. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil.

2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type in turf and plant bed areas: When available, the topsoil shall be 50% existing surface soil stripped and stockpiled. Determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash, or other material over 11/2 inches diameter. Topsoil shall be free from viable plants and plant parts. Topsoil shall also be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Weight of Lime: 2 tons per acre.
2. Weight of Commercial Fertilizer: 12-12-12 (NPK) 667 pounds per acre.

C. Planting-Soil Type in turf and plant bed areas: Imported, naturally formed soil from off- site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.

2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 5.5 to 8.0 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

3. Unacceptable Properties: Clean soil of the following:

   a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of **8** percent by dry weight of the imported soil.

c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches (38 mm) in any dimension.

4. Amended Soil Composition: Blend imported, unamended soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

a. Ratio of Loose Compost to Soil: 1:4 by volume.
b. Weight of Lime: 2 tons per acre.
c. Weight of Commercial Fertilizer: 12-12-12 (NPK) 667 pounds per acre.

D. Planting-Soil Type for rain gardens: Manufactured soil consisting of manufacturer's 50% sand, 30% topsoil, and 20% organic compost blended in a manufacturing facility with, stabilized organic soil amendments, and other materials to produce viable planting soil. The soil mix shall be homogeneous.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 5.5 to 6.5 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.

2. Unacceptable Properties: Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches (38 mm) in any dimension.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 90 percent calcium carbonate equivalent and as follows:

1. Class: O, with a minimum of 95 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through a No. 60 (0.25-mm) sieve.

2. Form: Provide lime in form of ground dolomitic limestone or mollusk shells.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.

C. Perlite: Horticultural perlite, soil amendment grade.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent

passing through a No. 50 (0.30-mm) sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Organic-Matter Content: 30 to 40 percent of dry weight.

2. Particle Size: Minimum of 98 percent passing through a 1-inch (25-mm) sieve.

B. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch (13-mm) sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.5 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

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

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

B. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation:

1. Plant Bed: Till subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

    a. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 6 inches (150 mm)of subgrade. Spread remainder of planting soil.

2. Sod: Till subgrade to a minimum depth of 2 inches (50 mm). Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

    a. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches (50 mm) of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depths indicated in subsections B.1 and B.2 above, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

    a. Mix lime with dry soil before mixing fertilizer.
    b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 12 inches (300 mm) in loose depth for material compacted by compaction equipment, and not more than [6 inches (150 mm) in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in- place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Refer to Section 329300 “Plants” for Placing Soil in Rain Garden Planters.

C. Application: Spread planting soil to total depth indicated on Drawings, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 12 inches (300 mm) in loose depth for material compacted by compaction equipment, and not more than in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply 6 inches (150 mm) of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests:

1. Compaction: Test rain garden planting-soil compaction after placing all lifts and at completion using a densitometer or soil compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D2668 (85% compaction). Space test at no less than one for each rain garden of in-place soil or part thereof.
2. Infiltration: Test rain garden planting-soil infiltration after placing all lifts. Prior to planting a mulching, wet the surface of the rain garden with a hose until saturated. Space tests at no less than one for each rain garden of in-place soil or part thereof. Fill the testing area to a depth of 4-inches and track the time it takes to completely draw down. Repeat test 3 times. If the water in any of the tests fails to draw down in less than an hour (i.e. infiltration rate = 4 inches/hour), add compost and gravelly sand to the mix and re-till.

C. Soil will be considered defective if it does not pass tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sodding.
2. Erosion-control materials.

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and

percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

   a. Landscape Industry Certified Technician - Exterior.
   b. Landscape Industry Certified Lawn Care Manager.
   c. Landscape Industry Certified Lawn Care Technician.

4. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March through May.
2. Fall Planting: September through November.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: **Certified**, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports

2.3 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.4 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.

2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod. Week 2 water 1/4 inch (6 mm) every other day. Week 3 water 1/4 inch (6 mm) every third day. Week 4 water 1/4 inch (6 mm) every fourth day.

3.6 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary turf-watering equipment to convey water from sources and to keep turf uniformly moist. Evenly distribute water over entire area designated for sodding, using even spray patterns. Do not water between the hours of 12:00 pm and 6:00 pm when daytime temperatures exceed 95 degrees F. After initial establishment period, continue intermittent

watering of newly established sod during the summer months 12-months after the date of Substantial Completion.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bermudagrass to a height of 1/2 to 1 inch (13 to 25 mm).

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to turf area.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by the Landscape Architect:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Sodded Turf: 12 months from date of Substantial Completion.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
3. Section 329600 "Transplanting" for transplanting non-nursery-grown trees.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

B. Unit prices apply to authorized work covered by quantity allowances.

C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

1.4 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in- ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Plant Bed: Areas to be planted that are not sodded, seeded, or rain garden.

L. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.

M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

P. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.5 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Mulch: 1-pint (0.5-L) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Weed Control Barrier: 12 by 12 inches (300 by 300 mm).
3. Proprietary Root-Ball-Stabilization Device: One unit.
4. Slow-Release, Tree-Watering Device: One unit of each size required.
5. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."

2. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials ten days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March through May.
2. Fall Planting: September through November.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization, edgings, and tree watering devices.

d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:
a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

2.2 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Pine straw.
2. Size Range: [inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color: Natural.

2.3 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.4 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Steel Fence T-Post, 1-3/4 inches x 3-1/2 inches x 6 feet tall, green enamel coating with anchor plate at the bottom.
2. Wood Deadmen: Timbers measuring 8 inches (200 mm) in diameter and 48 inches (1200 mm) long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
4. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cables: Five-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated compression spring, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

B. Root-Ball Stabilization Materials:

1. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

    a. Platipus Tree Anchoring System, or approved equal.

2.5 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. DuraEdge or approved equal.
2. Edging Size: 1/4 inch (6.4 mm) thick by 5 inches (125 mm) deep.
3. Stakes: Tapered steel, a minimum of 15 inches (380 mm) long.
4. Accessories: Standard tapered ends, corners, and splicers.
5. Finish: Weathered.

    a. Paint Color: unpainted.

2.6 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over two to three weeks; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

1. Color: dark chocolate or tan.

2.7 MISCELLANEOUS PRODUCTS

A. Rain Garden Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D448 for Size No. 8.

B. Rain Garden Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil in Plant Beds: Blend planting soil with tilled existing soil in place.

C. Placing Manufactured Planting Soil in Plant Beds: Place manufactured planting soil over exposed subgrade.

D. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits in Rain Garden: Planting during soil installation.

1. Rain garden trees shall be placed as the manufactured soil lifts are being installed. No excavation of manufactured soil in these areas shall take place.

B. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate non-rain garden planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected overnight, after working hours, and when unattended by Installer's personnel.

C. Backfill Soil: Subsoil and topsoil removed from excavations may be used as 50% of the

backfill soil unless otherwise indicated.

D. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) to 2 inches (50 mm) above adjacent finish grades.

1. Backfill: Planting soil. For trees, use 50% excavated soil mixed with imported soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: Planting soil. For trees, shrubs, ornamental grasses, and groundcovers use 50% excavated soil mixed with imported soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying:

a. Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

b. Stake trees with two stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; three stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.

2. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 14 feet (4.2 m) in height and more than 3 inches (75 mm) in caliper unless otherwise indicated.

1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

a. Securely attach guys to stakes 30 inches (760 mm) long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide compression spring for each guy wire and tighten securely.

b. Support trees with guy cable, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to compression spring. Allow enough slack to avoid rigid restraint of tree.

c. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.

2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.8 PLACING SOIL IN RAIN GARDEN PLANTERS

A. Place a layer of drainage gravel at least 12 inches (300 mm) thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches (150 mm) up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting soil as indicated in the drawings and Section 329113 "Soil Preparation".

3.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring 3-inch (75-mm) average thickness, with 24-inch (600-mm) radius around trunks or stems. Do not place mulch within 6 inches (150 mm) of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inch (75-mm) average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches (150 mm) of trunks or stems.

3.11 INSTALLATION OF EDGING

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven

below top elevation of edging.

3.12 INSTALLATION OF SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.13 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.14 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.15 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree.
2. Species of Replacement Trees: Same species being replaced.

3.16 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.17 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. PVC pipe and fittings.
2. Non-pressure transition couplings.
3. Expansion joints and deflection fittings.
4. Cleanouts.
5. Drains.
6. Encasement for piping.
7. Manholes.
8. Catch basins.
9. Stormwater inlets.
10. Pipe outlets.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. **Catch basins** and **stormwater inlets**. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less

than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets in accordance with manufacturer's written rigging instructions.

1.8 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:

1. Notify Construction Manager and Owner no fewer than five days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Source Limitations: Obtain hub-and-spigot, cast-iron soil pipe and fittings from single manufacturer.

B. Pipe and Fittings:

1. Marked with CISPI collective trademark and NSF certification mark.
2. Class: ASTM A74, Service and Extra Heavy class(es).

C. Gaskets: ASTM C564, rubber.

D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.2 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. PVC Cellular-Core Piping:

1. PVC Cellular-Core Pipe and Fittings: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D3034, SDR 35 or SDR-26, PVC socket-type fittings.

D. Adhesive Primer: ASTM F656.

2.3 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C443 (ASTM C443M), rubber.
2. For Cast-Iron Soil Pipes: ASTM C564, rubber.
3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.
2. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
2. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.4 PRESSURE PIPE COUPLINGS

A. Source Limitations: Obtain pressure pipe couplings from single manufacturer.

B. Description: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

C. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150- (1035-) psig (kPa) minimum pressure rating and ends sized to fit adjoining pipes.

D. Center-Sleeve Material: Manufacturer's standard.

E. Gasket Material: Natural or synthetic rubber.

F. Metal Component Finish: Corrosion-resistant coating or material.

2.5 DRAINS

A. Cast-Iron Area Drains:

1. Source Limitations: Obtain cast-iron area drains from single manufacturer.
2. Description: ASME A112.6.3 gray-iron round body with anchor flange and round[**secured**] grate. Include bottom outlet with inside caulk or spigot connection, of sizes indicated.
3. Top-Loading Classification(s): Heavy Duty.

B. Grate Openings: See standard plan for grate opening details.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
9. Steps: ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, PP, wide enough to

   allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 (1500) inches (mm).

10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:

1. Description: ASTM C913; designed in accordance with ASTM C890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into manhole walls, for each pipe connection.
5. Steps: ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 (1500)
inches (mm).
6. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318 (ACI 318M), ACI 350 (ACI 350M), and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 0 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C478 (ASTM C478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch (102-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C990 (ASTM C990M), bitumen or butyl rubber.

6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
8. Pipe Connectors: ASTM C923 (ASTM C923M), resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C913, precast, reinforced concrete; designed in accordance with ASTM C890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

1. Joint Sealants: ASTM C990 (ASTM C990M), bitumen or butyl rubber.

2. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
4. Pipe Connectors: ASTM C923 (ASTM C923M), resilient, of size required, for each pipe connecting to base section.

C. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

D. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.9 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions in accordance with utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions in accordance with utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions in accordance with utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty, in accordance with utility standards.

2.10 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Filter Stone: In accordance with NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where

specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe- jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping in accordance with the following:

1. Install piping pitched down in direction of flow.
3. Install piping with 12 inch minimum cover.
4. Install PVC cellular-core piping in accordance with ASTM D2321 and ASTM F1668.
5. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.
6. Install PVC profile gravity sewer piping in accordance with ASTM D2321 and ASTM F1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:

1. Join PVC cellular-core piping in accordance with ASTM D2321 and ASTM F891 for solvent-cemented joints.
2. Join PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.
3. Join PVC profile gravity sewer piping in accordance with ASTM D2321 for elastomeric-seal joints or ASTM F794 for gasketed joints.
4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.

B. Fasten grates to drains if indicated.

C. Set drain frames and covers with tops flush with pavement surface.

D. Assemble trench sections with flanged joints.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops **3 (76)** inches (mm) above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318 (ACI 318M).

3.9 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Section 221413 "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to

underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa) unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to sediment interceptors specified in Section 221323 "Sanitary Waste Interceptors."

E. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. [**Unshielded**] [**Shielded**] flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.10 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping in accordance with ASTM F1417.

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 (1035) psig (kPa).

a. Ductile-Iron Piping: Test in accordance with AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test in accordance with AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334200